# FORECLOSURE AND CRIME IN A SUBURBAN SETTING

by

Zoe E. Vitter
A Thesis
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of
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# Abstract

FORECLOSURE AND CRIME IN A SUBURBAN SETTING

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This research examines the relationship between foreclosure and crime within the context of a middle-class, rapidly growing outer suburb during the foreclosure crisis that began in 2006. Previous research has found that concentrated residential foreclosure, long-term vacancy, and property abandonment in urban areas is associated with increases in crime and disorder. Calls for police service, real estate transactions, and socio-economic data from 2004 through the end of 2009 were aggregated into pre- and post-periods. Using multiple linear regression, a small but statistically significant relationship between crime and foreclosure, was found, which held even when demographic and environmental variables, and previous crime rate were added to the model. Previous crime rate of a neighborhood, mobility in both the pre- and post-period, and retail employment also positively predicted crime and were statistically significant. Percent Hispanic population negatively predicted crime.

## Introduction

The dramatic rise and fall of regional housing markets in the United States over the last ten years provides a unique opportunity to explore the effects of foreclosure and residential instability on crime rates. During the first years of the new century many areas in the country experienced rapid growth in the rate of home ownership along with substantial appreciation of home values. This trend was especially prevalent among minority populations (Krainer, 2008). The tide of ever increasing home values and rates of home ownership began to reverse in the middle of the decade. In 2007 the nation experienced the first drop in the median price of existing homes since the Great Depression (Gravelle, Labonte, Whittaker, & Hungerford, 2009). While foreclosure rates have been rising slowly for decades (Immergluck & Smith, 2006b), they skyrocketed after 2006. There is no national independent measure of foreclosure rates (Immergluck, 2010), but they appear to have quadrupled between 2006 and 2009. Realtytrack reports that 1 in every 45 households in the United States, or 2.21%, received at least one foreclosure filing in 2009 compared to 0.58% of households in 2006. The Mortgage Bankers Association estimates that 4.5% of all home loans were in foreclosure by the end of 2009, compared to 1% in early 2006 (Jones, 2010).

Foreclosure can have negative consequences for individuals, communities and the nation, and these effects tend to be cumulative. While homeowners may lose their homes,

the equity that has been invested in their property, and their good credit ratings to

foreclosure (Kingsley, Smith, & Price, 2009), the effects of a foreclosure do not stop at

the property line. When one home on a block goes to foreclosure the value of neighboring

homes is reduced (Immergluck & Smith, 2006a; Shlay & Whitman, 2006). The impact of

foreclosures on the nation's overall economy can be equally negative (Jones, 2010). The

family home is the primary asset for most American families; when its value decreases

they feel less comfortable spending money regardless of whether their real income has

changed (Moreno, 1995). Decreases in household consumption, home sales and new

construction increase the rate of unemployment, which can lead to additional foreclosures

(Gravelle et al., 2009).

The effects of foreclosure also extend beyond purely financial considerations.

Concentrated residential foreclosure, long-term vacancy and property abandonment in

urban areas is closely associated with increases in social problems, disorder and crime.

Together these factors contributed to the decline of American inner-cities in the second

half of the twentieth century (Immergluck & Smith, 2006a; Taylor, 2010). Even without

this history it seems reasonable to assume that increases in foreclosure would stimulate

additional crime because of the social and physical consequences associated with

foreclosure and its tendency to concentrate in some locations but it is not a question that

has undergone much study. There is some previous research to indicate that increasing

foreclosure rates does increase the crime rate of the surrounding neighborhood in urban

areas (Immergluck & Smith, 2006b). In addition to the paucity of evidence, we cannot

assume that this foreclosure crisis led to rising crime because the causes of foreclosure

and the places where it has concentrated in the current crisis are in many ways different than the context of its concentration in earlier decades (Immergluck, 2008). As a result it is difficult to say if past consequences of foreclosure will repeat themselves in the current crisis.

This study examines the relationship between foreclosure and crime within the context of the exurb[1], or rapidly growing outer-ring suburb. It attempts to determine, first, if increasing numbers and concentration of foreclosures increase crime in these suburban places. Secondly, what are the other influences on crime in these places, and how are they different from the traditional urban location where most criminological research occurs?

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[1] The Brookings Institute defined exurb as " as communities located on the urban fringe that have at least 20 percent of their workers commuting to jobs in an urbanized area, exhibit low housing density, and have relatively high population growth" in a 2006 study of the subject (Berube, Singer, Wilson, & Frey, 2006).

**The Foreclosure Crisis and Geographic Patterning**

In order to understand some of the geographic patterning of foreclosure, it is important to understand a bit about how the current foreclosure crisis occurred. The rapid expansion in the use of subprime and adjustable rate mortgages (ARM) after 2001 appears to be a driving factor of at least the initial wave of foreclosures (Edminton & Zalneraitis, 2007). These terms encompass a variety of products that generally have lower underwriting standards, but higher interest rates and costs for the borrower (Jones, 2010, pp. 5–7). These types of mortgages are more likely to end in foreclosure than conventional loans (Immergluck & Smith, 2005). Subprime and ARM loans were most prevalent in rapidly growing communities and for minority borrowers (Pence, 2008).

Borrowers with subprime mortgages tended to concentrate in the outer suburban regions of some metropolitan areas. While the greater availability of subprime loans made homeownership possible for more people, increased competition for housing caused the rapid appreciation of homes, which priced many of those would-be first-time buyers out of the market (Edminton & Zalneraitis, 2007). Many of these potential buyers flocked to outer suburban areas, where home prices were lowest (Metropolitan Washington Council of Governments, 2006). The addition of new buyers into the marketplace further inflated prices in these areas, making the lowest-cost homeownership

less affordable, which further encouraged the use of subprime loans. For some time, default rates on these mortgages were kept artificially low because of the rapid appreciation in the housing market in these places. When home prices appreciate the borrowers who are in danger of default can easily sell or refinance their homes to avoid foreclosure (Edminton & Zalneraitis, 2007). This type of sale is not possible if prices decline and the housing market becomes stagnant.

We would expect that use of subprime loans would concentrate among young borrowers and low to moderate income families, because they were created for use with high-risk borrowers: people with little, no, or damaged credit history. Over the last decade however, these loans were also disproportionately marketed and sold to minority homebuyers and owners. Even after controlling for income, credit history and other risk factors, minority borrowers were at least 30% more likely to receive a higher-rate subprime loan than white borrowers (Bocian, Ernst, & Li, 2006). These populations were also more likely to have been sold products with high pre-payment penalties (Bocian et al., 2006)  and to have a larger portion of their assets tied up in their homes' value (Furlong, 2008). These details leave borrowers less able to restructure or refinance ARM mortgages (Jones, 2010) and more vulnerable to foreclosure (Immergluck & Smith, 2005).

There are other factors that make foreclosures likely to cluster within these larger areas. Previous research has shown that a foreclosed home reduces the value of homes nearby. In Philadelphia researchers showed that homes within 150 feet of a vacant home had their value reduced by more than 10% (Shlay & Whitman, 2006). Homes within one-

eighth of a mile of a foreclosure decreased in value by more than one percent in Chicago, with higher effects noted in low or moderate income neighborhoods (Immergluck & Smith, 2006a). Other studies have found that declines in values grow with larger numbers of foreclosures (Hartley, 2010). There are several explanations for this effect. A home that has been abandoned and left vacant may be in visible disrepair, making nearby homes for sale less appealing for homebuyers (Immergluck & Smith, 2006a). A bank-owned home may lower the value of other homes nearby because banks may be willing to take a loss on their investment and list these properties at substantially lower prices than nearby comparable properties (Reid, 2008). Buyers may be less willing to buy a home if the percentage of homes either vacant or for sale in the immediate area is too high (Hartley, 2010).

**The Foreclosure Process**

Foreclosure should be understood as a process and not just an event (Hartley, 2010; Wilson & Paulson, 2010). The process varies widely from state to state, and according to the note-holder's policy (Immergluck, 2008), but there are elements common to most foreclosures. Generally borrowers enter default when they are 30 days overdue on a mortgage payment, and enter serious default when they are about 90 days delinquent. The bank sends official notice to the borrower and the legal foreclosure proceedings begin. Next, the property is sold at auction for the amount owed (the total amount of the note and fees). If no one bids on the property it reverts to bank ownership until it is resold (Hartley, 2010). The minimum time from first delinquency to auction is

about four months, but it may take years, and the financial pressure the borrower is under likely begins long before the first delinquency.

While not always feasible for a homeowner, it is possible to stop the foreclosure process and minimize its negative effects to the community at any point. Aside from paying the money owed, as most borrowers who are less than 90 days behind do (Grover & Lenhart, 2008), borrowers in pre-foreclosure may refinance the existing loan or sell the home for at least the outstanding amount owed (Edminton & Zalneraitis, 2007). Even if the property goes all the way to auction, vacancy can be avoided if it is purchased by a third party at that time. Finally, it is thought that homes that are bank-owned for longer periods of time are more damaging to communities than homes that are quickly resold to a third party (Apgar, Duda, & Gorey, 2005; Kobie, 2010).

**Possible Ramifications of Foreclosure**

In addition to the negative financial effects of foreclosure there may be social and physical consequences that affect individuals and neighborhoods. These effects, individually or collectively, may increase crime. Individually, the borrower is presumably under great financial pressure while struggling to pay the mortgage before and during the foreclosure process. This financial pressure may strain community and family relationships (Jones, 2010). Adults in the home may work longer hours to try to make ends meet, or parents who had stayed at home may enter the workforce. Homeowners may not have the time, money, or desire to maintain their homes (Hartley, 2010; Wilson & Paulson, 2010). Borrowers in default may carry a great deal of shame and avoid their normal interactions. Some homeowners in this position walk away, or abandon, their

homes while others may stay until they are evicted by the bank. Foreclosure is surprisingly expensive to borrowers in default (Moreno, 1995). Their weak financial position and poor credit rating makes finding a new place to live difficult (Hartley, 2010; Jones, 2010). Under these circumstances relationships in the community may be more likely to end with a "forced" relocation than in an ordinary local move.

When a member of the community leaves unexpectedly the neighborhood can suffer a variety of negative social consequences. Departures from the community can create gaps in local voluntary organizations or informal social networks (Jones, 2010; Wilson & Paulson, 2010). If the home remains vacant after it is abandoned the vacant home is an empty space on a block where relationships cannot be formed with new tenants. The vacant home may reduce the number of people who may supervise activity in the neighborhood and can prevent normal patterns of activity, such as neighborhood children playing outside together (Wilson & Paulson, 2010).

Shaw and McKay's (1942) social disorganization theory finds that delinquent behavior is more likely to concentrate in communities with a high degree of poverty, residential mobility, and ethnic and racial heterogeneity. People do not have time to form relationships with neighbors in places with rapid population turnover and they are less interested in committing to a community that they plan to leave (Bursik, 1988; Kornhauser, 1978). Racial and ethnic heterogeneity inhibit effective communication about shared goals, which further discourages friendship and participation in community organizations (Bursik, 1988). Poverty forces people to settle in these places and influences their decision to stay. They move to "bad" neighborhoods because they cannot

afford to live anywhere else and they typically leave as soon as they are economically

able to (Shaw & McKay, 1942). Poverty also leaves residents less able to ameliorate their

problems (Shaw & McKay, 1942). Crime and delinquency is ultimately a result of a

community's inability to transmit a single image of appropriate, conventional behavior to

its children because community traditions, institutions and relationships have broken

down or cannot be formed (Shaw & McKay, 1942).

It is important to note that these primary elements alone are not the direct cause of

higher rates of crime (Bursik, 1988; Sampson & Groves, 1989; Shaw & McKay, 1942).

In a furtherance of social disorganization theory, Sampson and Groves (1989)

hypothesized that dense social networks and the existence of, and participation in,

volunteer associations in a community mediated the relationship between delinquency

and the structural and social characteristics of a neighborhood. While residential mobility

has been found to have a positive relationship with local friendship ties (Sampson &

Groves, 1989), the relationship between either of these variables and crime is more

questionable in today's highly mobile society. Sampson, et al. (1997) thus defined

collective efficacy as a more "task-specific construct" that allows communities to work

together for a common goal, regardless of their friendship ties (Morenoff, Sampson, &

Raudenbush, 2001).

According to social disorganization theory, more crime may result from increased

foreclosure because increased financial pressure or economic insecurity, residential

mobility, declining population, and fear of crime as a result of abandoned homes may end

or prevent the formation of community relationships. Less social cohesiveness could

create an environment where there is less social control over people in the neighborhood and fewer people who are willing or able to guard against criminal activity. As disorganization grows, new people moving to the neighborhood are less likely to commit to it, further exacerbating the disorganization.

The social disorganization perspective does not fully address the issues foreclosures raise, however, because it overlooks the opportunistic nature of many crimes, and that the foreclosed home itself could also be considered a target or haven for crime. Vacant homes often broadcast their vacancy with brightly colored stickers warning of no water, untended lawns or even large signs advertising auction.

According to routine activities theory, crime is more likely to occur when three minimum necessary elements converge: a motivated offender, a suitable target and the absence of a capable guardian (Cohen & Felson, 1979). The rate of those occurrences will be predicted by patterns of behavior, movement and interaction of potential offenders, victims and guardians in time and space, and make crime, or certain types of crime, to be more likely in some locations than others (Cohen & Felson, 1979).

From the routine activity perspective, a vacant home presents an opportunity for crime. The vacant home may become the target of criminal activity such as gutting to find materials for re-sale, vandalism, and arson; alternately the vacant home may be used as a place to commit crimes such as drug use, sales or prostitution. A vacant home may also increase crime by decreasing potential guardianship; street crime may be more inviting if there are fewer people to keep an eye out on the block. Conversely, we might

expect a declining population to precede a drop in crime if fewer people are in an area, because there are fewer potential interactions between offenders and suitable targets.

Finally, the tendency of foreclosures to concentrate in specific places could make them more likely to affect crime rates. If our 2009 national foreclosure rate were spread evenly throughout the country it would be unlikely to have much of an impact, but it is not. For a variety of reasons, it has concentrated in some places at very high rates. Some of the places where foreclosures concentrated most recently also throw doubt on the possibility of criminogenic effects of foreclosure. The next section will explore where those places are.

While a vacant housing variable is included in some research models, it has only recently become the focus of study. There is only one published quantitative study that explores the relationship between foreclosure and crime. Immergluck and Smith (2006a) looked at increasing rates of foreclosure in Chicago neighborhoods in the early 2000s and found that one standard deviation increase in the foreclosure rate increases a neighborhood's violent crime rate by nearly seven percent.

**Location and Concentration**

This most recent wave of foreclosures is not only notable for its historically high rates, but also for the types of places in which it concentrated. While inner-city homeowners living in low-income areas continue to be disproportionately represented among foreclosure activity, since 2007 many outer-ring suburban or exurban locations have experienced dense clustering of foreclosure activity. For example, a 2002 study in the Minneapolis metropolitan region found that foreclosures nearly always concentrate in

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specific areas of the central cities (Grover, Smith, & Todd, 2007). In contrast, a 2007 study in the same area found that foreclosure rates in zip code areas varied significantly across the region, from 15 to 65%, with the majority of foreclosures occurring in inner-city and exurban areas (Grover & Lenhart, 2008). Across the 100 largest statistical areas (MSAs) of the United States in 2008, while suburban locations overall have been found to have lower rates of foreclosure compared to central cities, outer suburban areas have been shown to have a disproportionately high share of foreclosure activity as compared to other suburban locations (Immergluck, 2009).

These middle and high income exurban locations were among the fastest growing areas in the United States in the early 2000s (Immergluck, 2009; Krainer, 2008), a quality predicted by social disorganization theory to result in lower rates of delinquent behavior (Shaw & McKay, 1942). Prior to the recent dramatic rise in the foreclosure rate, Immergluck and Smith (2006a) hypothesize that even if foreclosures did occur more often in middle and high income neighborhoods, they would not have the same adverse impact on crime rates as foreclosures in low-income neighborhoods. Because housing markets in these places are stronger, it was assumed that these foreclosures would be quickly reabsorbed into the market, rather than result in concentrations of long-term vacancy and abandonment of homes. The patterns of foreclosure over the last several years provide good reason to question these assumptions.

While the suburbs that ring our cities bring to mind homogenous settings and people, open spaces, and greater overall affluence and safety (Briffault, 1990), some modern suburban municipalities encompass much more diversity. Suburban areas have

seen steady increases in population density, ethnic, racial and economic diversity over the last forty years (Hanlon, Vicino, & Short, 2006; Roh & Choo, 2008). Many suburban locations today are more demographically and economically diverse than some modern cities (Briffault, 1990). Unfortunately, suburban municipalities may also be less well equipped to deal with the problems that come from large numbers of foreclosures as compared to cities that have been coping with them for decades. Suburban locations are less likely to have the policies and staff for housing and community development (Immergluck, 2008) and social services (Kneebone & Garr, 2010) in place to deal with the effects of foreclosure. Once suburban neighborhoods decline, they lack amenities, such as universities, museums, as well as large job or cultural centers that attract people to visit and they are less able to secure federal economic assistance, which in turn would leave them less able to revitalize blighted neighborhoods (Briffault, 1990; Swanstrom, Casey, Flack, & Dreier, 2004).

There is also some reason to believe that concentration of foreclosure activity in suburban areas may have different consequences than in cities. Kobie (2009) researched the effect of foreclosures on sales prices of nearby homes in Cuyahoga County, Ohio, an area that includes the state's largest city, Cleveland. He found that the presence of homes in the foreclosure process in suburban areas did significantly negatively affect the price of nearby homes, but found no negative affect from foreclosures in the city of Cleveland. It is possible that disorder in residential areas has a greater impact in suburban areas, where they make up a greater portion of the landscape and are set apart from public and commercial areas (Brown, Perkins, & Brown, 2004).

As reviewed above, there are good reasons to believe, based on theory and previous research, that there may be a relationship between foreclosure and crime. The relationship between residential instability and crime has been shown in previous research, although the results are not always consistent (Sampson, Morenoff, & Gannon-Rowley, 2002). This study explores these relationships with a longitudinal observational design in eastern Prince William County, Virginia, an outer-suburban area of the Washington, D.C. metropolitan area.

**Hypothesis**

Because concentrations of foreclosure have social and physical consequences that may negatively affect personal relationships and present greater opportunity for crime, the rate of foreclosure is expected to have a direct impact on the crime rate. While previous research has shown that concentrations of foreclosure and vacancy can increase crime rates in low-income, inner-city neighborhoods, they might not have the same effect in middle and upper income suburban locations thought to be less susceptible to crime or as likely to have long-term vacancy and abandonment issues (Immergluck & Smith, 2006).

Foreclosure activity in the Washington D.C. metropolitan area was patterned in many of the ways that were discussed above. In 2008-9, when the national average of housing units listed in a foreclosure filing was 11.9 per thousand, Prince William County's rate, 17 per thousand, was the highest in the region (The Urban Institute, 2009). Foreclosure activity was not randomly spread throughout Prince William, but

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concentrated in some neighborhoods while others were left nearly untouched (McClain & Fowler, 2008).

Drawing upon the theories and previous literature discussed above, the model for this study incorporates aspects of social disorganization, opportunity and place-based theories. The crime rate is thought to be influenced by the rate of foreclosure, residential mobility, economic, demographic and opportunity factors.

Hypothesis: Controlling for mobility, economic disadvantage, demographic and opportunity factors, increases in the rate of foreclosure in suburban neighborhoods will increase the crime rate of those neighborhoods.

<center>**Methodology**</center>

This section will describe the methodology of this research. Information about the research setting is presented. The sources of data used in this research are identified and the variables are also described.

**Setting**

Prince William County is located approximately 35 miles south of Washington, D.C. (see Figure 1) and has many of the characteristics of places that have been discussed above. For several decades it has had a high rate of residential instability and a rapidly increasing population, home prices appreciated rapidly in the first years of the new century only to decrease even more dramatically with the onset of the foreclosure crisis, and it is demographically and economically diverse location.
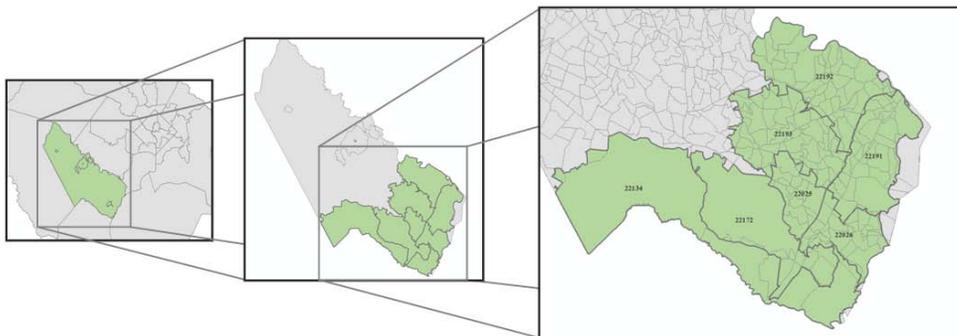


**Figure 1: The study area in southeastern Prince William County, Virginia**

The 2007 estimated population of Prince William was 386,047, a 37.5% increase over the population in 2000. Like many exurban areas of the United States, rapid growth has been a constant in Prince William for some time: between 1970 and 2000, the population grew 153%.

Between 2000 and 2007, housing prices in the Washington region rose to the third highest ranking in the country; only the housing markets in Los Angeles and Miami were higher. The median price of a home in the Washington D.C. area increased from $180,500 in 2000 to $420,000 in 2006 (McClain & Fowler, 2008). While home prices in Prince William also rose astronomically during this time, its average sales price of a home remained well below that of the region. In the first quarter of 2005, the average sales price of a home in Prince William was more than $100,000 less than that of nearby jurisdictions and the District of Columbia (Metropolitan Washington Council of Governments, 2006). Prices fell across the region when the housing crisis hit but the change was more dramatic in Prince William County. Between October of 2007 and 2008, the value of existing homes in the Washington metropolitan area declined about 19%, near the average of other large metropolitan areas across the United States during that time (McClain & Fowler, 2008). In Prince William County, however, the average existing home price fell by 34.7%, or $137,100 (McClain, 2009). Crime in Prince William is not a common event, and the crime rate has been steadily decreasing for some time. Between 1995 and 2009, the part I crime rate in Prince William decreased by nearly half: it was 39.1 per thousand residents in 1995, and in 2009 it stood at 19.5 per thousand

residents. This decrease is due to an actual decrease in crime (9,637 incidents in 1995 compared to 7,649 incidents in 2009) and a rapidly increasing population (PWC crime stats, 2009).

Throughout the study period, Prince William has had a low rate of unemployment when compared with the rest of the nation. From 1995 until the middle of 2008, Prince William County's unemployment rate hovered between two and three percent; it reached four percent by the end of that year, and 6.4% by January of 2010 (Bureau of Labor Statistics), the lowest of the 15 largest job markets in the United States (Fuller, 2010).

## Sources Of Data & Description Of Variables

This section will define the variables, describe their source, and provide some descriptive statistics for these variables in their originating unit of analysis. Data used for this research were originally collected by several Prince William County municipal agencies for other purposes. I will describe the data as it was originally recorded, the originating agency and their purpose for collecting the information. This section will also provide some basic descriptions of the variables in their original unit of analysis.

### Dependent Variable

Crime is measured with calls for service to Prince William County Police between January 1, 2004 and December 31, 2009. Using calls for police service has a number of advantages over other measures of crime. Other official measurements of crime, such as arrest or report data, may more accurately gauge official reaction to crime rather than crime itself (Warner & Pierce, 1993). Calls for service also occur more frequently than other official measures of crime. This latter quality is beneficial to this research, given the

relatively low overall rate of crime in this location and the relatively small unit of

analysis, because calls for service can provide a larger number and stronger potential

statistical strength (Kurtz, Koons, & Taylor, 1998).

The Prince William County Police Department (PWCPD) automatically records

every instance of police officer dispatch. These dispatches are a result of emergency calls

from private individuals using 9-1-1 and officer initiated stops. The police department

maintains these records for a variety of purposes. Each incident includes: the date of the

call, an offense description and code number, a street description, and geographic

coordinates. Street descriptions were removed to protect the anonymity of the caller and

victim, if any.

Each time a police officer is dispatched, the call receives an event number;

repeated event numbers, indicating multiple calls for the same incident, were removed by

PWCPD. In addition to the emergency 9-1-1 system, Prince William County Police

Department maintains a non-emergency reporting number, where requests for assistance

with nuisance issues, such as graffiti or noise may be made; these types of calls were not

included in this data.

In all, 2,420,573 calls for service were recorded between January 1, 2004 and

December 31, 2009. Nearly 2 million of these, or 83%, were placed accidently or for a

reason outside the scope of this research and were removed (see Table 1). The largest

percentage of these calls, 32%, were made to report a health, safety or mental health

incident such as illness, suicide attempt, or transportation of a "mental subject." At 22%,

the next largest percentage of calls related to vehicles or traffic situations, such as parking

violations, vehicle stops, accidents, road obstructions, and DUI[2]. Response to private and

retail alarms accounted for 10% of all calls. Calls regarding animals made up 6% of all

**Table 1: Number & percent of calls for service removed**

| Calls outside study scope (all calls N = 2,420,573) | | |
| --- | --- | --- |
| **Reason for Removal** | **# Removed** | **% of Total** |
| 911 errors (hang-ups, misdial, ect.) | -80,725 | 3.3 |
| Alarms | -238,781 | 9.9 |
| Animal | -142,711 | 5.9 |
| Citizen complaint - unspecified | -55,677 | 2.3 |
| Misc. Health / mental health | -772,431 | 31.9 |
| Misc. (airplane crash, cell escort, shoplifting, ect.) | -137,842 | 5.7 |
| Outside of locality | -1,203 | 0.0 |
| No reason given | -889 | 0.0 |
| School - unspecified | -29,451 | 1.2 |
| Vehicle/ traffic (inc. DUI) | -528,995 | 21.9 |
| Warrant service | -8,311 | 0.3 |
| **Total calls outside scope removed** | **-1,997,016** | **82.5** |

| Calls within scope (N = 423,557) | | |
| --- | --- | --- |
| **Reason for removal** | **# Removed** | **% of Total within scope** |
| Geocode fail | -15,713 | 3.7 |
| Outside study area | -162,532 | 38.4 |
| Non-residential & outlier drop | -6,601 | 1.6 |
| **Total calls within scope removed** | **-184,846** | 43.6 |

**All CFS 2004-2009 remaining: N = 238,711**

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[2] DUI is a serious criminal offense but it is literally a moving violation; as such it is
difficult to assign the offense to a specific location.

calls, as did a wide variety of miscellaneous process or criminal calls that are outside the scope of this research. These include items as varied as airplane crashes and reports of weapons of mass destruction to shoplifter in custody. About 3% of all calls were 9-1-1 errors, and unspecified calls from individuals or schools made up another 3%. Finally, calls from outside the County, warrant service, or no reason given each made up less than 1% of all calls.

The remaining 423,557 were imported to ARC Map 10.0 in order to map the coordinates. Approximately 4% of these values failed to map. Once the coordinates were linked to the unit of analysis, the calls that were placed from outside the study area were removed, leaving 245,312 calls for service for analysis.

**Table 2: Categories & subcategories of crime**

| Violent Crime | Property Crime | Domestic Crime | Disorder |
| --- | --- | --- | --- |
| Abduction | Burglary | Child abuse | Abandon auto |
| Armed robbery | Larceny | Domestic dispute | Alcohol violation |
| Assault | Prowler | | Curfew |
| Fighting | Tamper vehicle | | Disorderly |
| Homicide | Trespasser | | Drug related |
| Hostage situation | Vandalism | | Firearm |
| Missiles | Vehicle theft | | Indecent exposure |
| Rape | | | Intoxication |
| Shooting | | | Loitering |
| Stabbing | | | Noise |
| Strong-arm | | | Pan handling |
| | | | Suspicious |

Police used 92 different descriptions of purpose for call in these remaining calls for service. These were consolidated into 33 categories. For example, the descriptions disorderly, disorderly in progress, disorderly in progress / injury, and disorderly near school all became disorderly. These 33 specific descriptions were then categorized as violent or property crime, domestic, or disorder (see Table 2).

There is not much variation in the annual number of calls for service between 2004 and the end of 2009. There were fewer calls for service in 2004 (64,576 calls), the first year of the study, than any other year. The number of calls increased gradually each
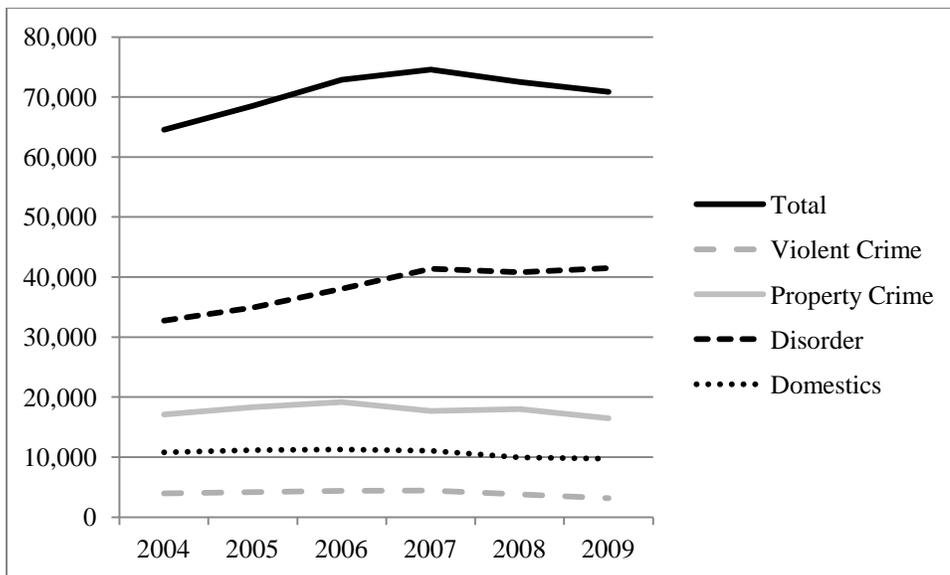


**Figure 2: Calls for service, by broad category & year**

subsequent year, peaking at 74,562 in 2007. The number of calls for service decreased by about 2,000 calls a year in the remaining years of the study. When broken out by general

crime type, it appears that the increases in the first years of the study come primarily from disorder and property crime, while the subsequent decreases can be seen in property and violent crime as well as domestics, while disorder (the largest category of calls) leveled off (see Figure 2).

**Independent Variable**

The measure of foreclosure is defined as the number of foreclosures in an area. Data for this measure were gathered from Prince William County's database of real estate transactions. All real estate transactions recorded at the county courthouse that involve land and improved property in the county are collected by the County Assessments Office and maintained by the Office of Information Technology for the purpose of annually estimating the value of property for local tax assessments. These data are available to the public.

Many variables are recorded during each real estate transaction. For the purposes of this study, the relevant fields of information are: sale date, property street address, use code (indicates type of structure), the sale class, and the assessed value of the land and improvements. The field SALE_CLASS indicates the type of sale in the real estate transaction that was recorded: a foreclosure is indicated by the sale class code XC, the subsequent bank sale is indicated by the sale class code XB, and valid sales are indicated by V or in some years a blank field.

Many of the 123,621 real estate transactions recorded in Prince William between 2004 and 2009 were removed prior to analysis (see Table 3). Because information on real estate transactions is collected to track ownership and for the purpose of local tax

assessment, many of those recorded are not relevant to this research and were dropped

prior to analysis. First, transactions involving any improvement added to the parcel

during the calendar year, which indicates land developers pulling permits to build new

homes on newly created parcels or the first sale of a newly built home, were removed.

Second, transactions stemming from the development of land, indicated by land

assemblage or parceling (XA, XM), were removed. Third, transactions that involved a

single family, including family sales, quitclaims and gifts, were removed. Finally,

transactions that involve the sale of land from one corporate entity to another, incorporate

sales, and ownership interest sales were removed.

**Table 3: Number & percent of real estate transactions removed**

| Reason for Removal | # Removed | % of Total |
|---|---|---|
| Other sales codes | -36,233 | 29.3 |
| Other zip codes | -43,485 | 49.7 |
| Geocode fail | -66 | 0.2 |
| Drop TAZ | -177 | 0.4 |
| **Total removed** | **-79,961** | **79.6** |

**All Transactions 2004-2009 remaining: N = 43,660**

Some transaction categories are differentiated for purposes of tax assessment but

still do indicate the movement of people. Sales classified as "other bad sale," indicating

that the sale price may be greater or less than market value, were included. Transactions

classified as trustee sales were also included, as these do indicate the movement of

24

residents. New home sales were also left in the file. Short sales were included as valid

sales. There were 87,388 sales remaining following this process.

Sales that were made in Prince William County but fell outside of the study area

were removed next, leaving 43,903 real estate transactions. The data was carefully

cleaned: any incomplete addresses were checked in the Prince William County Mapper

XM, an interactive on-line GIS property viewer that lists parcel information. Sales dates

were matched in order to verify the transaction and complete the address. As a result,

when the data was imported to ARC GIS and geocoded, only 66 transactions were lost (a
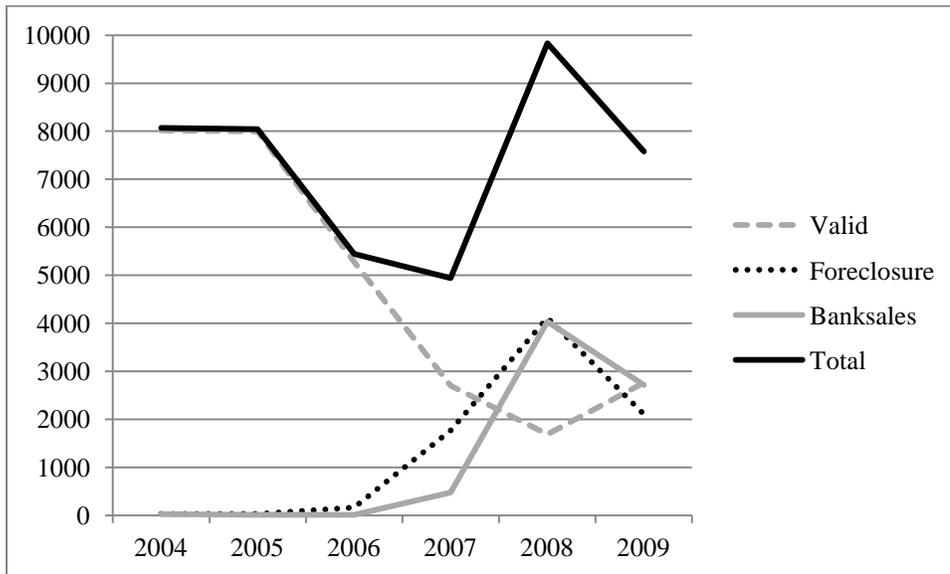
success rate of 99.8%).



**Figure 3: Real estate transactions, by category & year**

As can be clearly seen in Figure 3, foreclosures and bank sales represented only a small fraction of all sales prior to 2007. The number of valid sales drop very steeply in 2006, while foreclosures increase more than 10-fold between 2006 and 2007. Bank sales lag behind foreclosures, but both peak in 2008, the same year that valid sales bottom out. Total sales, which include foreclosure and bank sales, peak in 2008, with nearly 2,000 more sales than at the height of the pre-crash market.

## Controls

There are two sources of data for control variables in addition to the sources of data discussed above: Prince William County Public Schools (PWCPS), and data collected for infrastructure planning purposes. The measures of economic disadvantage, mobility ethnicity and race, non-English speaking households, and chronic absenteeism are taken from PWCPS data. The population estimates, number of homes, and number of persons employed in each neighborhood comes from the infrastructure data.

The PWCPS system collects information on the student body each school year under federal reporting requirements related to the No Child Left Behind Act of 2001. Information is collected via a combination of parent/ guardian survey and official records. It is gathered at individual school sites and assembled at PWCPS's Office of Accountability, which has annually produced a school data profile for every public school in the County since the 2004-2005 school year.

There are 50 schools whose attendance boundaries are within the study area, including 33 elementary, 11 middle, and 6 high schools. The population of these schools ranges from a low of 40,545 students in the 2007-2008 school year to a high of 42,994

students in the 2009-2010 school year. The total estimated population of the study area was 193,774 in 2005 and 217,354 in 2010. The school population represents about one-fifth of the total population inside the study area.

The census is the traditional source for demographic information utilized in this type of analysis. There are a number of reasons why, in this case, the demographic information collected by schools is more useful. First, the schools provide an annual measure for fairly small geographic units; in contrast, the census only provides data in geographic units smaller than the county level every ten years. Prince William County had undergone such rapid growth between 2000 and 2006, both by numbers and by the level of diversity, that the socio-demographic makeup of the County in many locations changed dramatically in the six years between the 2000 census and the rise in foreclosure. Remarkably, the socio-demographic makeup of the county may have substantially changed again between 2006 and 2010, when the next decennial census occurred, perhaps at least in part as a result of the foreclosure crisis. Where available, the 2010 Census estimates for the variables follow the school data for purposes of comparison.

**Residential Mobility**

A high rate of residential mobility is predicted by social disorganization theory to decrease local friendship ties or networks and commitment to the community. More social interaction and greater commitment is thought to increase informal social control, which increases guardianship and decreases crime. While parts of these relationships have been found to be true in some studies, the findings are not consistent (Sampson et al., 2002). Some believe that Shaw and McKay's (1949) observation of a relationship

between residential stability and lower rates of crime may relate to patterns of movement that no longer hold true today. A combination of higher overall mobility among the population and concentration of the poorest in subsidized housing may mean that some of the most stable neighborhoods today are among the poorest and most crime-ridden (Roh & Choo, 2008).

Prince William County overall has a lower rate of residential stability than the national average. In 2000, only 45.6% of Prince William County residents reported that they lived in the same residence as five years earlier (U.S. Census), and residential instability may have been even higher between 2000 and 2007, when home values were rising more rapidly.

As we have already noted, the number of real estate transactions taking place in the county dropped dramatically beginning in 2005. Nearly three-quarters of Prince William residents own their own home, so while some of these transactions represent new people moving into the county, most are people moving within the county. The foreclosure crisis may have decreased residential stability in the county because of forced moves, or it may have increased residential stability as declining home values and few buyers, in effect, "forced" people to stay. If greater residential stability does translate into a greater social control and less crime, then increases in residential stability could offset destabilizing effects of foreclosure.

There are two variables that measure mobility. The first variable is the rate of valid sales of existing homes between 2004 and 2006. This data comes from the real estate transactions reviewed above. The total number of valid sales over those three years

was divided by the number of homes in the study area estimated in 2005. There were 19,600 valid sales during the pre-period, and an estimated 123,379 existing homes in 2005. The valid sales rate for this period of time throughout the study area is 15.9%

The second variable is a mobility index reported by each school. The schools measure mobility as the number of students entering or withdrawn from the school over the course of the school year, divided by the number of students enrolled in the school on October 1. The mean was taken from 2007 through 2009. This mobility measure measures movements of home owners and renters. The schools' mobility index ranges from a low of 7.4 to a high of 38 with a mean of 23.

For purposes of comparison, mobility is measured by the census as the percentage of persons who were living at the same address a year before completing the form. This measure is likely to render a lower percentage than the school's measure of mobility: students who leave a school and come back during the same school year are counted twice by the schools' mobility measure, but would not be counted at all by the census' measure. On the other hand, the pre-real estate rate is likely lower than then Census' figures, as it only measures homeowner moves. The 2010 Census finds that nearly 17% of the County's population was not living at the same address a year ago, which is on par with expectations.

**Demographic Information**

Another of social disorganization theory's primary sources of disorganization in neighborhoods is increased racial and ethnic heterogeneity (Shaw & McKay, 1942 [1972]).  Cultural differences, or even lack of a shared language, are thought to lead to

difficulties creating shared norms and effectively communicating those norms with each other and to the neighborhood's children. Some previous research constructs a heterogeneity index to explicitly measure the overall make up of neighborhoods, while other research utilizes percentages of racial subgroups directly.

In the last 20 years, suburban localities south of Washington D.C. have become some of the most diverse locations in the country (Rivlin et al., 2008). Between 1990 and 2007, the percentage of foreign-born residents of Prince William increased from 6.2% to 21.9% (76,000) of the population (PWC Demographic 2007). In 2007, nearly 20% (14,489) of the county's public school students were reported as limited English proficient. The foreign-born population is also very diverse: while nearly three-quarters speak Spanish, 103 different languages are counted among these students (PWCPS); according to the 2006 American Community Survey, about 54% of foreign born residents originated from Latin America, 31% from Asia, 10% from Africa and 5% were from Europe (PWC Demographic 2007).

Not only do many of Prince William County's neighborhoods have very diverse populations, but this diversity is a relatively recent occurrence. The majority of population growth over the last decade has come from increases in the immigrant and minority populations (Rivlin et al., 2008). In 1990, 83.3% of people living in the County were White, 11.6% Black, all other races only made up about 5% of the population, and 95.5% were of non-Hispanic origin. By 2006, only 59.7% of Prince William residents reported their race as White, while the population of Black residents had risen to 18.6%, more than 14% reported race as other or multiple races, the Asian population had risen to

7.6%, and those reporting their ethnicity as Hispanic had risen to 19.1% (PWC Demographic 2007).

Prince William County Schools define racial and ethnic makeup measures as the percentage of the student body from each school who describes themselves as: Asian/ Pacific Islander, Black/ African-American, Hispanic, white non-Hispanic, and other. Aligning with the makeup of the county, the schools of Prince William County are racially and ethnically diverse. Black students make up between 11% and 56% of the population of schools in the study area, with a mean of 29%. White students make up between 11% and 73% of these school's populations, with a mean of 32%. Other races, including Asian-American students, constitute 4% to 22% of the population, with a mean of 12%. Between 9% and 64% of schools' populations are Hispanic, with a mean of 30%.

These demographic estimates are a reasonable estimate of the demographics of the area when compared with results of the 2010 census of the four political subdivisions that make up the study area[3]. According to the measure of population that measures race and ethnicity together (consistent with the school data), only White and Hispanic students have more than 5% difference in mean percent of the population. These particular groups were the most likely to be affected by community changes over the course of the decade, and the differences between the school and Census data are in the direction expected. White and Asian people are underrepresented in the schools compared to their presence in the general population, while Hispanic, Black and other races are overrepresented.

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[3] These are Dumfries, Lake Ridge, Neabsco and Woodbridge Magisterial Districts.

**Table 4: Percent differences between school & general population of study area**

| Race/ Ethnicity | School Population | Area Population | Difference of Mean % | Difference of Minimum % | Difference of Maximum % |
|---|---|---|---|---|---|
| **Other** | 5.20 | **0.58** | 4.62 | **0.27** | **10.69** |
| **Asian** | 6.64 | **6.97** | -0.33 | **-2.61** | **3.09** |
| **Black** | 28.68 | **26.18** | 2.51 | **-8.62** | **26.09** |
| **White** | 29.73 | **39.52** | -9.79 | **-19.85** | **19.45** |
| **Hispanic** | 29.73 | **23.15** | 6.58 | **-5.35** | **31.65** |

These differences may also be due in at least some part to the geographic size of the area being measured. School attendance zones are smaller than the magisterial districts that the Census data is reported in. We can expect that there would be greater variation in racial and ethnic concentration at a smaller geographic level. As can be seen in Table 4, this appears to be the case: there is a wider range of representation for every demographic category at the school attendance level than there is at the magisterial level.

Students of PWCPS are counted as non-English speakers if they have been evaluated and qualify for Limited English Proficiency (LEP) services; they continue to be counted by this measure annually until they test out of the program. Across the schools in the study area, the mean percentage of students who receive LEP services is 25% with a range of 3% to 61%.

There is no census question that directly corresponds to the measure of percentage of children who enter school with no or little knowledge of English, and qualify for LEP. There are two items, however, that do approach the topic: the percent of foreign born persons, and the percent of persons aged five or older that speak a language other than English at home. The 2010 Census reports that nearly 30% of people spoke a language

other than English at home and more than 21% were foreign born. While neither of these items addresses the ability to speak English directly, the figure does indicate that the PWCPS mean measure of 25.1 is a reasonable estimate.

**Economic Information**

Poverty has long been associated with higher rates of crime. Social disorganization theory suggests that poverty reduces a community's ability to ameliorate its problems. Alternately, proponents of routine activities theory may maintain that increased poverty leads to an increase in the number of motivated offenders. Therefore, a measure of economic disadvantage is included in the model.

Poverty in Prince William County is not the norm, but it does exist. Its residents are more likely to have college degrees and own their own home than the average American (ACS, 2006-2008). The 2006 median income in the County was over $80,000, significantly higher than that of Virginia ($57,869) or the country ($48,200) (Rivlin et al., 2008), but also the lowest in the municipalities in the Washington, D.C. metropolitan area (ACS 2007). Likewise, while housing costs are the least expensive in the region, they are still very expensive compared to other areas of the country ("MWCOG," 2004), leaving less money for everything else.

Economic disadvantage is defined by PWCPS as the percentage of the student body from each school who are eligible for the federal free and reduced lunch program, Temporary Assistance for Needy Families (TANF), or Medicaid, and students identified as homeless or migrant workers (Woolfrey, 4/29/2010). With the exception of foster children, these are programs which the student's parent or guardian must apply for to

receive; if the family has not applied for any federal, state or local assistance, or for the free and reduced lunch program itself, they will not be counted by this measure. On the other hand, many of these programs allow families who have incomes well above the federal poverty line to participate. Between 8.5% and 76% of students attending schools in the study area are identified as economically disadvantaged, with a mean of 42%.

We can reasonably expect the school measure of economic disadvantage to be more sensitive than that of the Census and thus include more people. The schools' measure of economic disadvantage is more inclusive than the poverty measure used by the Census. The Census Bureau uses federal poverty guidelines, while the school measure includes students who qualify for several different government programs. There are varying thresholds for inclusion in these programs, but most allow incomes above the federal poverty line. In 2005, for example, families whose incomes were 1.85% higher than the guidelines would qualify for reduced lunch (Fed. Reg. 2004). In addition to this, children are also more likely to live in poverty than the population as a whole (Brooks-Gunn 1997). The Census finds that only 5.3% of the county's population is living below the poverty line.

Unsupervised youth are more likely than supervised youth to become either motivated offenders or potential victims in the view of opportunity theories, and they are perhaps the basis of the problem in the view of Social Disorganization. The schools report the percent of students who are chronically absent, because they are more likely to have behavior problems, to read below grade level, and ultimately drop out of school. Chronic absenteeism is measured as a percentage of students who are absent 10 or more

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days in a school year. Between 12% and 54% of students at these schools were absent from school ten or more days in one school year, with a mean of 24%. There is no equivalent measure with the Census.

Opportunity theories predict that the meeting of motivated offender and potential target in the absence of an effective guardian will be determined in part by the routine activities of those involved and the rhythm and tempo of the place (Cohen & Felson, 1979). In this view, more people passing through a place will create more crime. Previous research indicates that the presence of some businesses in mixed-use neighborhoods increase crime. Population and employment estimates are reviewed in the next section.

**Table 5: Summary of control variables 2004 - 2009, by school**

| Variable | # of Obs. | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|---|
| Chronic Absenteeism | 48 | 24.08 | 8.92 | 11.52 | 53.52 |
| Mobility | 48 | 22.83 | 7.77 | 7.40 | 37.86 |
| Economic Disadvantage | 48 | 42.34 | 18.15 | 8.52 | 76.18 |
| Other | 48 | 5.20 | 1.95 | 0.82 | 11.32 |
| Asian | 48 | 6.64 | 1.78 | 3.30 | 10.72 |
| Black | 48 | 28.68 | 9.83 | 10.85 | 55.50 |
| White | 48 | 29.73 | 15.10 | 9.56 | 71.25 |
| Immigrant | 48 | 25.17 | 14.64 | 3.05 | 60.62 |
| Hispanic | 48 | 29.73 | 14.90 | 8.75 | 63.54 |

Economic, demographic and opportunity factors are included in this model because they are predicted by theory to affect a neighborhood's crime rate. Including these factors in the model measures their separate influence on the dependent variable and their effect on the other independent variables. Without controlling for these factors,

I would be unable to determine if increases in foreclosure rates affected crime rates, or if another factor, such as poverty, affected both. A summary of descriptive statistics for all control variables is in Table 5.

## Unit of Analysis

Prince William County maintains and publicly reports information on estimated population, number of residences by type, and the number of workers by type in created geographic areas called Traffic Analysis Zones (TAZ). The purpose of TAZ data is to forecast local and regional infrastructure needs. These data are reported in 5-year increments that are updated annually by Prince William County Planning Office and Demographic Office staff. The TAZ file used in this research is from 2009.

The number of residences, categorized as single-family homes, townhomes, or multi-family dwellings, are gathered through the decennial census and updated by the Prince William County Planning Office as new permits for development are issued. Population estimates in non-census years are based on a formula which uses the mean number of people living in each type of residence in the last decennial census. The number of workers, categorized as industrial, retail, office and other, are gathered through the County's Office of Economic Development for reporting to the Virginia Employment Commission.

The whole of Prince William County is divided into 651 TAZs; 199 of these are in the study area. In 2005, the population of the study area is estimated at 213,398 people in 123,379 housing units. By 2010, the population had grown to 239,270 and nearly 7,000 new housing units had been built. The counts from the 2010 census were used to

**Table 6: Summary Statistics of Variables in TAZs**

| Variable | Median | 25th % | 75% | Smallest | Largest | Mean | SD | Skew | Kurtosis |
|---|---|---|---|---|---|---|---|---|---|
| Acreage of TAZ | 209.80 | 122.80 | 353.60 | 17.00 | 1809.00 | 276.10 | 252.10 | + | HT |
| Total Crime 04-06 | 515.00 | 164.00 | 1160.50 | 4.00 | 4848.00 | 795.10 | 895.60 | + | HT |
| Total Crime 07-09 | 566.50 | 160.50 | 1126.00 | 5.00 | 4451.00 | 817.80 | 871.00 | + | HT |
| Foreclosure 07-09 | 27.50 | 5.00 | 88.50 | 0.00 | 325.00 | 53.70 | 64.80 | + | HT |
| Mobility | 20.50 | 16.20 | 24.60 | 9.70 | 32.00 | 20.90 | 5.40 | 0 | 0 |
| Chronic Absenteeism | 32.10 | 28.10 | 33.70 | 21.60 | 38.50 | 31.20 | 3.50 | 0 | 0 |
| % Asian | 6.90 | 6.00 | 7.70 | 5.00 | 9.30 | 6.90 | 1.10 | 0 | 0 |
| % Black | 29.60 | 23.70 | 33.50 | 11.90 | 50.80 | 30.40 | 8.40 | 0 | 0 |
| % Hispanic | 23.00 | 18.60 | 35.20 | 11.20 | 53.60 | 26.40 | 10.80 | 0 | 0 |
| % White | 28.90 | 20.00 | 42.70 | 12.70 | 62.20 | 31.3 | 12.90 | 0 | 0 |
| % Other | 5.10 | 4.30 | 5.60 | 2.30 | 7.30 | 5.00 | 1.00 | 0 | 0 |
| Economic Disadvantag | 39.00 | 29.00 | 49.70 | 13.30 | 67.10 | 39.40 | 13.10 | 0 | 0 |
| % Immigrant | 15.40 | 11.70 | 23.70 | 3.30 | 31.90 | 16.80 | 7.10 | 0 | 0 |
| Retail Employment | 16.50 | 2.00 | 100.00 | 0.00 | 623.00 | 72.50 | 111.50 | + | HT |
| Valid Sales Rate 04-06 | 0.26 | 0.13 | 0.37 | 0.00 | 1.01 | 0.28 | 0.18 | 0 | 0 |
| Pop 2005 | 1026.00 | 424.50 | 1920.50 | 0.00 | 8900.00 | 1365.00 | 1285.90 | + | HT |
| Pop 2008 | 1115.00 | 434.00 | 2072.00 | 49.00 | 9222.50 | 1447.90 | 1333.70 | + | HT |
| Tot Housing 05 | 354.00 | 133.00 | 707.50 | 0.00 | 3266.00 | 479.70 | 469.60 | + | HT |
| Tot Housing 08 | 359.80 | 143.50 | 725.50 | 18.00 | 3333.00 | 501.90 | 478.00 | + | HT |

confirm this estimate. While the boundaries of TAZs do not perfectly align with 2010 census tract boundaries, the tracts that nearly overlay the study area show a 2010 population of 239,690. The study area comprises about 60% of the county's population and housing units, but less than a third of its land area. There are nearly 55,000 jobs estimated to be in the study area, about 54% of the county's total number. Most of these jobs, 42%, are retail, about 30% are office employment, 14% are industrial and 16% are classified as 'other'.

## Descriptive Statistics of Variables in TAZs

All variables are interval or higher level of measurement, so reporting the mean, standard deviation and range of each variable in each study year is appropriate in order to explore the diversity of the measures across TAZs in each year. In order to describe changes over time, the variables from the three study years before the foreclosure crisis began: 2004, 2005, and 2006, will be averaged together and compared to the average of the study years when the foreclosure rate is significantly higher: 2007, 2008, and 2009.

The four data sets used in this analysis used in this analysis report information in three different geographic units: calls for service and real estate transactions are reported at the address level, socio-economic data is reported in school-attendance areas, and population and employment information is reported in administrative geographic unit of Prince William County traffic analysis zones. The first step is to separate or aggregate the information into a common unit of analysis. TAZs are used as the unit of analysis. While not natural neighborhoods, TAZs offer population and housing estimates and are on

average smaller than the average elementary school attendance zones. Table 6 (above) displays the summary statistics describing the TAZs.



**Figure 4: Illustrating average size of TAZs, with 25th and 75th percentile acres & street centerlines**

All of these data are positively skewed and leptokurtic. As a result, the median may be more representative of the data then the mean. TAZs are not evenly sized and range from 17 to 1809 acres with a median of 210 acres. It is easier to visualize both the skew and the actual size of these areas with the map (Figure 4) above. TAZ 1940D is a few acres bigger than three-quarters of all TAZs, and its immediate neighbor to the south,

TAZ 1940E is a few acres bigger than about one-quarter of the sample. Street centerlines are included in the illustration to help the reader visualize the infrastructure at these places. By 2010 half of all TAZs contained 386 residences that housed about 1,200 people.

**Calls for service**

Individual geographic coordinate points were aggregated into either a pre (2004 through 2006) or a post (2007 through 2009) period. Using Arc GIS 10.0, each data point (or incident) was joined to the TAZ it is located in. During this process each TAZ is given a count and sum of the numeric attributes of the points that fall inside it. The result was then saved out as a separate layer. In this manner, the total number of calls for each TAZ was extracted, as well as the number of calls for each general crime category: violent and property crimes, and disorder and domestic incidents. The number of crimes during the pre-period was divided by the 2005 population of the TAZ in order to create pre-period crime rate. For the post-period, the number of crimes that occurred between 2007 and 2009 were totaled.

**Foreclosure**

Individual geographic coordinate points were also aggregated to TAZs and into either a pre (2004 through 2006) or a post (2007 through 2009) period. The total number of real estate transactions for each TAZ was extracted for each category of sales: new homes, valid sales of existing homes, bank sales and foreclosures. A transaction rate was calculated for each sales type using the same procedure as outlined above for calls for service, using the number of homes as the divisor in each TAZ rather than population.

**Socio-economic**

Unlike the previous variables that involved aggregating point data, School attendance zones are polygons of various sizes that overlap between school levels. While there are many common borders between school levels and TAZ boundaries, many TAZs contain more than one school attendance zone.
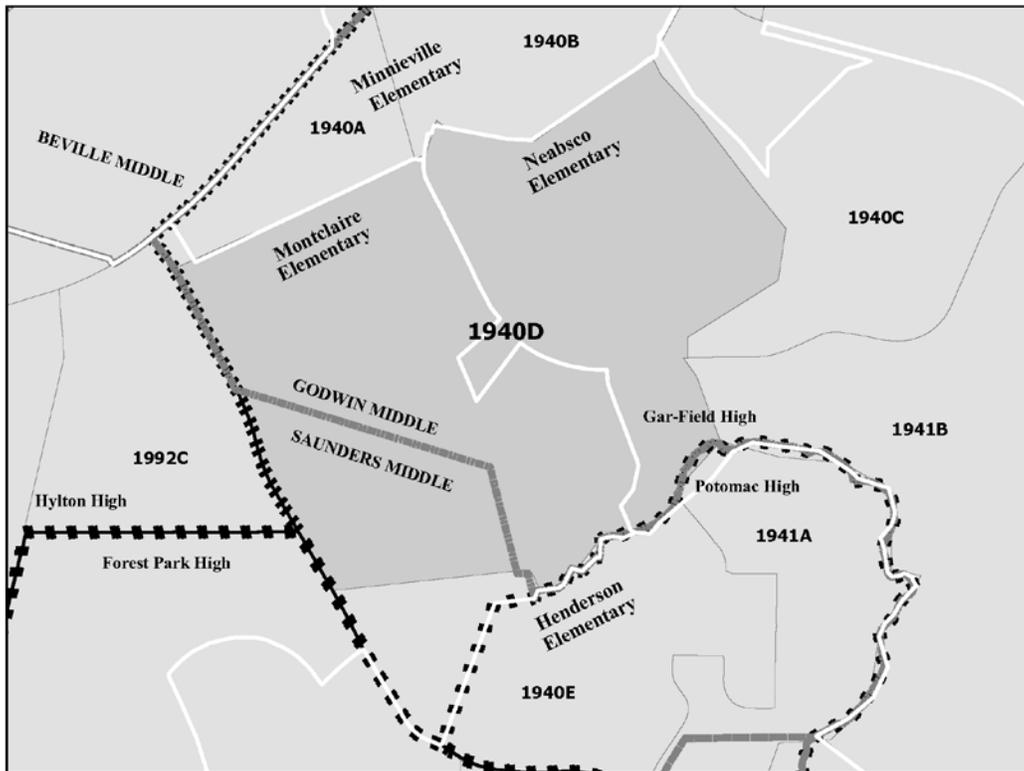


**Figure 5: Illustrating school attendance boundary lines & TAZs**

To estimate the values of socio-economic variables within each TAZ, each school attendance area was intersected with TAZ areas in Arc GIS 10.0. The intersect tool

calculates the percentage of area one set of polygons overlays another. In the map above (Figure 5), for example, TAZ 1940D is 9/20 Neabsco Elementary and 11/20 Montclair Elementary Schools, 1/5 in Saunders Middle and 4/5 Rippon Middle Schools, and entirely within Gar-Field High School's attendance boundary lines.

This process was repeated for elementary, middle and high school boundaries. The table from each newly created layer was exported to Excel and sorted by TAZ. The values for school attendance zones that were in more than one TAZ, about 14% of the total overall, were allocated to each TAZ based on the proportion of the area of the attendance zone within that TAZ (following Stucky & Ottensmann, 2009). This procedure produces 74 unique demographic combinations across the remaining TAZs[4]. Of these combinations, 68 only appear once, 17 appear twice, 3 appear 3 times, 2 each appear 4, 5, and 6 times, and 1 combination appears 7 times.

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[4] The 141 TAZs that remain in the analysis, see below.

## Analysis & Results

In order to model the relationship between foreclosure and crime while controlling for demographic and neighborhood variables, and further to test that relationship with multiple regression, the datasets described above were united in Stata where the summary statistics were examined. Because this research is specifically focusing on the effects of residential changes, calls for service from the 56 areas that have 5 or fewer residences in 2005 were removed. There were two TAZs within an independent town, which has a town hall and police station, that were outliers for crime. The high rate of calls for service from these two areas are likely to be a result of crimes that were reported to the PWC Police from the police station in that area but did not necessarily occur there. These observations were also dropped. There are 141 observations remaining.

**Table 7: Model 1: Untransformed bivariate**

| Source | SS | df | MS | Number of obs = | | 141 |
|--------|-----|-----|-----|-----------------|---|-----|
| | | | | F( 1, 146) = | | 311.93 |
| Model | 74498860.7 | 1 | 74498860.7 | Prob > F = | | 0.0000 |
| Residual | 33197181.6 | 139 | 238828.645 | R-squared = | | 0.6918 |
| | | | | Adj R-squared = | | 0.6895 |
| Total | 107696042 | 140 | 769257.445 | Root MSE = | | 488.7 |
| Crime 07-9 | b | Std. Err. | t | P>|t| | 95% Conf. Interval | |
| Foreclose 07-9 | 11.238 | 0.636 | 17.660 | 0.000 | 9.980 | 12.496 |
| Constant | 189.591 | 54.574 | 3.470 | 0.001 | 81.688 | 297.493 |

As stated above, the both crime and foreclosure in the post-period are positively skewed and highly peaked. Variables that are distributed non-normally can indicate that residual errors will not be identically, independently, and normally distributed, violating an assumption of multiple regression. The diagnostics from the initial bivariate regression showed that this was indeed a problem. Foreclosure is significant in this model and the coefficients would still be accurate if the variables were left alone, however, the p-values for t-tests and F-tests would not be valid. Various transformation options were explored
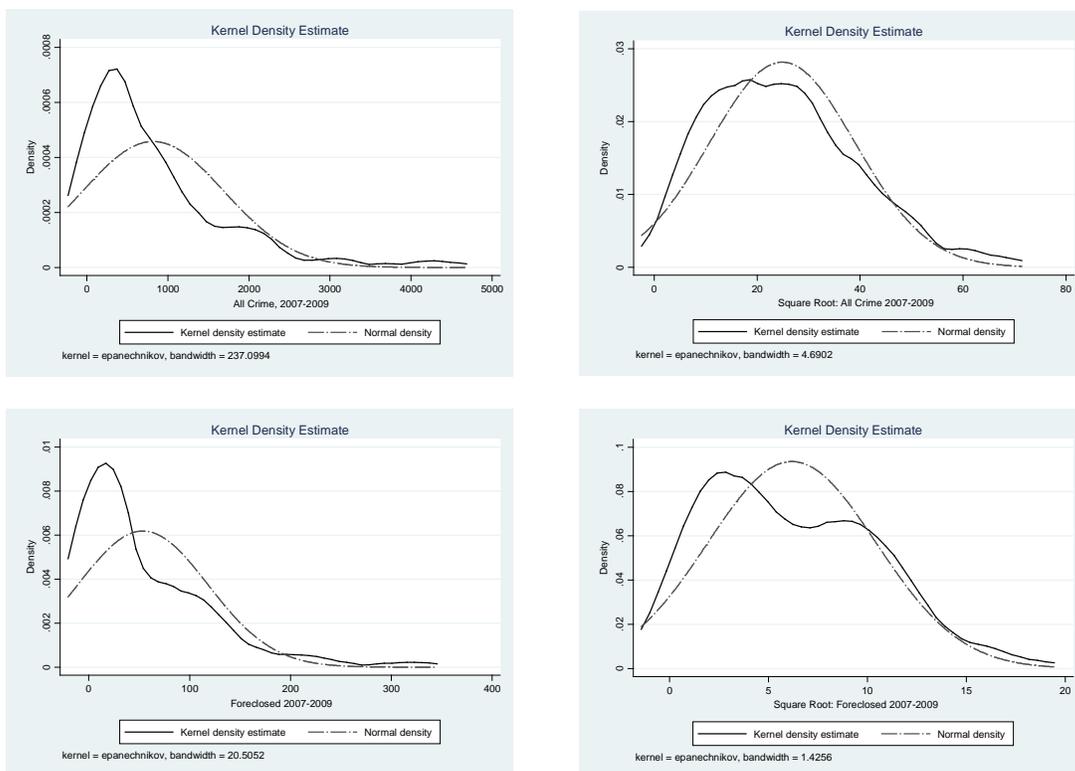


**Figure 6: Kernel density estimates of crime (top) & foreclosure (bottom) 2007-2009, before (left) & after (right) square-root transformation**

in Stata using the gladder and ladder commands that allow visual and numeric inspection, respectively. Square root transformation was selected for both the independent and dependent variable. This transformation had the lowest chi-square value of the nine types of transformation tested by Stata, and created the most normal distribution.

As can be seen above (Figure 6), the transformations dramatically improve normality of the distribution of crime and foreclosure in the post-period. This improvement can also be seen in the distribution of the studentized residuals, and pnorm tests that measure normality in the middle range of the data. Homoscedasticity of residuals is also improved with transformation; this can be seen visually and with the Cameron & Trivedi's decomposition of IM test. Only some improvement was seen in the tails of the data, however. In addition, although the z scores are lower for the transformed model compared to the untransformed model, the Shapiro-Wilk W test for normal data continued to return significant results (i.e., we can reject the hypothesis that the residuals

**Table 8: Model 2: Transformed bivariate**

| Source | SS | df | MS | Number of obs = | | 141 |
|---|---|---|---|---|---|---|
| | | | | F( 1, 146) = | | 428.99 |
| Model | 21276.4 | 1 | 21276.4 | Prob > F = | | 0.0000 |
| Residual | 6893.9 | 139 | 49.6 | R-squared = | | 0.7553 |
| | | | | Adj R-squared = | | 0.7535 |
| Total | 28170.3 | 140 | 201.2 | Root MSE = | | 7.0425 |
| SqRt Crime 07-09 | b | Std. Err. | t | P>\|t\| | 95% CI | |
| SqRt FC 07-09 | 2.892 | 0.140 | 20.710 | 0.000 | 2.616 | 3.169 |
| Constant | 7.057 | 1.048 | 6.730 | 0.000 | 4.985 | 9.130 |

are normally distributed ). Overall, using the square root transformation on the dependent and independent variable does improve the residuals enough to make the process worthwhile. muzak

Examination of the correlations among the variables is also appropriate. Crime in the post-period is significantly associated with nearly all the variables listed above, with the exception higher percentages of Asian, or Black populations. There is a significant negative correlation with higher percentages of White populations and populations other than those listed here. The highest correlation between crime and other variables is that with foreclosure, but some portion of that correlation is due to both variables' strong relationship with population, which is not controlled for in this test. That is, more crime and more foreclosures can be expected in areas with more people and more homes.

Aside from population and crime, the strongest correlation with foreclosures is valid sales rate in 2004-2006. Consistent with prior research, areas with higher rates of sales between 2004-2006 are more strongly correlated with both crime and foreclosure. Higher sale rates may indicate increased mobility and less social control leading to more crime. Higher sale rates between 2004 and 2006 increase the likelihood of foreclosure because people who bought during this time were likely to pay more than people who purchased just a few years before - and they were more likely to become 'upside down' on their mortgages when prices fell. Foreclosure also has significant positive correlations to mobility, chronic absenteeism, percent Hispanic and/or immigrant population, economic disadvantage, and retail establishments. There are significant negative relationships

**Table 9: Correlations of Variables**

| | SqRt Crime 07-09 | FC Sqrt | Valid Sale 04-06 | Mobility | % Black | % Hispan | % White | % Asian | % Other | % Imm. | Economic Disadvan | Chronic Absent | Pop 2008 | Retail | SqRt Crime 04-06 | Spatial Lag |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SqRt Crime 07-09 | 1.000 | | | | | | | | | | | | | | | |
| FC Sqrt | 0.869 | 1.000 | | | | | | | | | | | | | | |
| Valid Sale Rate 04-06 | 0.570 | 0.635 | 1.000 | | | | | | | | | | | | | |
| Mobility | 0.409 | 0.331 | 0.157 | 1.000 | | | | | | | | | | | | |
| % Black | 0.118 | 0.137 | 0.065 | 0.428 | 1.000 | | | | | | | | | | | |
| % Hispanic | 0.363 | 0.337 | 0.186 | 0.749 | -0.124 | 1.000 | | | | | | | | | | |
| % White | -0.367 | -0.364 | -0.200 | -0.878 | -0.621 | -0.694 | 1.000 | | | | | | | | | |
| % Asian | 0.058 | 0.130 | 0.102 | 0.089 | 0.401 | 0.080 | -0.437 | 1.000 | | | | | | | | |
| % Other | -0.191 | -0.205 | -0.081 | -0.395 | 0.362 | -0.735 | 0.270 | 0.227 | 1.000 | | | | | | | |
| % Immigrant | 0.374 | 0.334 | 0.164 | 0.823 | 0.019 | 0.973 | -0.783 | 0.189 | -0.638 | 1.000 | | | | | | |
| Eco Disadvantage | 0.403 | 0.359 | 0.189 | 0.967 | 0.344 | 0.858 | -0.910 | 0.153 | -0.493 | 0.908 | 1.000 | | | | | |
| Chronic Absent | 0.270 | 0.222 | 0.098 | 0.839 | 0.641 | 0.457 | -0.802 | 0.172 | -0.169 | 0.565 | 0.772 | 1.000 | | | | |
| Population 08 | 0.768 | 0.772 | 0.327 | 0.128 | -0.002 | 0.173 | -0.142 | 0.080 | -0.083 | 0.158 | 0.135 | 0.037 | 1.000 | | | |
| Retail | 0.463 | 0.207 | 0.150 | 0.289 | -0.018 | 0.293 | -0.219 | -0.021 | -0.111 | 0.317 | 0.276 | 0.208 | 0.236 | 1.000 | | |
| SqRt Crime 04-06 | 0.970 | 0.863 | 0.538 | 0.381 | 0.076 | 0.364 | -0.336 | 0.023 | -0.215 | 0.364 | 0.386 | 0.244 | 0.786 | 0.407 | 1.000 | |
| Spatial Lag | 0.505 | 0.359 | 0.241 | 0.654 | -0.044 | 0.708 | -0.506 | -0.120 | -0.503 | 0.692 | 0.675 | 0.436 | 0.241 | 0.366 | 0.514 | 1.000 |

*Note: correlations that are bold and italicized are significant*

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between foreclosure and percent White and other populations. Percent of population that is Asian and Black show no relationship with either crime or with foreclosure.

Many of the remaining variables have significant positive or negative associations with each other. Rather than reviewing all of these correlations, there a few things to highlight. First, White population is negatively correlated with nearly everything else, most strongly with economic disadvantage (-0.91) and mobility (-0.88); the only positive association White population has is with populations of other race/ ethnicity than those specified here. Neighborhoods with higher percentages of White population are less likely to be areas that have higher percentages of minorities, immigrants, poverty, crime or foreclosure, and children from these areas are less likely to be chronically absent from school. Secondly, the measures of Hispanic and immigrant population are so highly correlated (0.97) that they might as well be measuring the same thing. This likely reflects the high percentage of immigration from Latino countries, although it may also indicate that recent immigrants from across the world and Hispanic populations settle in the same geographic areas. These areas are more likely to be more economically disadvantaged (0.91 and 0.86 respectively), have higher rates of crime (about 0.36), foreclosure (about 0.34) and be more mobile (0.82 and 0.75 respectively). Finally, mobility is so highly correlated with economic disadvantage (0.97) that the separate effects of each cannot be distinguished. This variable is also highly correlated with chronic absenteeism (0.84).

While these demographic patterns are interesting, they also present some real practical difficulties with the regression model. Multicollinearity, a problem that develops when two or more predictor variables in the model are highly correlated, can artificially inflate the standard errors of the coefficients (StatSoft, Inc., 2013). The scatter plots below graphically illustrate the linear relationship among some of the most highly correlated predictor variables. All variables, and then various combinations of them, were put into regression models in order to determine the extent of the multicollinearity by measuring the variance inflation factor (VIF).
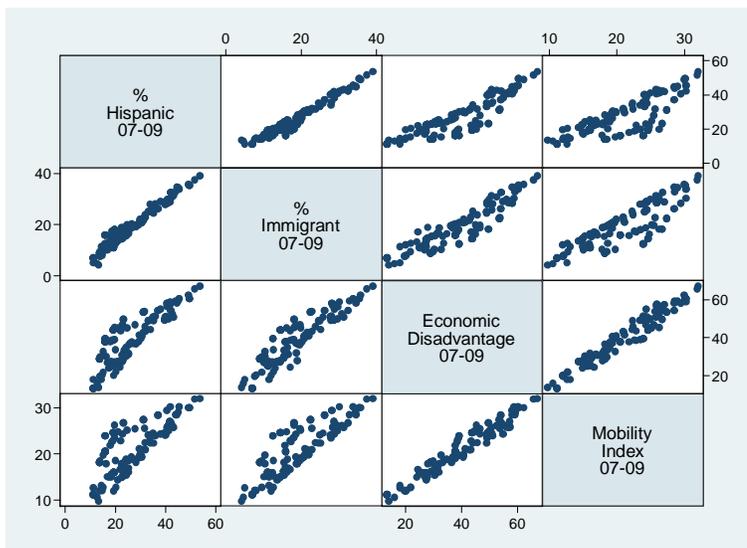


**Figure 7: Scatter plot matrix of the four variables that are most closely correlated: percent Hispanic, percent immigrant, economic disadvantage & mobility index**

Throughout these tests there were two pairs of variables that consistently exceeded the recommended tolerance of 10 (Chen, Ender, Mitchell, & Wells, ND) when

they were included together: these were economic disadvantage with mobility rate, and percent Hispanic with percent immigrant. VIF scores are acceptable with economic disadvantage and percent immigrant removed from the model. While these variables are important to the model, each of them correlate so highly with another variable still included in the model that their separate effects are indistinguishable.

With the assumptions of multivariate regression addressed, the next model (Model 3) included the crime and foreclosure in the post-period, and control variables that theory and or the correlation table suggest should also influence crime: the real estate rate in the pre period, population in 2008, mobility score from the post-period, percent of students chronically absent from school, and the number of retail establishments.

Table 10: Model 3: Demographic & environmental variables

| Source | SS | df | MS | Number of obs = | | 141 |
|---|---|---|---|---|---|---|
| | | | | F( 7, 133) = | | 131.13 |
| Model | 24605.0 | 7 | 3515.0 | Prob > F = | | 0.0000 |
| Residual | 3565.3 | 133 | 26.8 | R-squared = | | 0.8734 |
| | | | | Adj R-squared = | | 0.8668 |
| Total | 28170.3 | 140 | 201.2 | Root MSE = | | 5.1775 |
| SqRt Crime 07-09 | b | Std. Err. | t | P>|t| | 95% CI | |
| SqRt FC 07-09 | 1.690 | 0.229 | 7.380 | 0.000 | 1.237 | 2.142 |
| Real Estate 04-6 | 8.679 | 3.436 | 2.530 | 0.013 | 1.883 | 15.474 |
| Population 2008 | 0.003 | 0.001 | 4.900 | 0.000 | 0.002 | 0.004 |
| Mobility 07-9 | 0.839 | 0.234 | 3.590 | 0.000 | 0.376 | 1.302 |
| Chronic Absentee | -0.514 | 0.278 | -1.850 | 0.066 | -1.063 | 0.035 |
| Hispanic Pop | -0.173 | 0.072 | -2.400 | 0.018 | -0.315 | -0.030 |
| Retail Est | 0.031 | 0.004 | 7.470 | 0.000 | 0.023 | 0.040 |
| Constant | 8.637 | 5.840 | 1.480 | 0.142 | -2.915 | 20.189 |

Foreclosure, the real estate rate, population, mobility, and retail establishments are all statistically significant predictors of crime in this model. Percent of the population that identifies as Hispanic is also statistically significant, negatively predicting crime. Chronic absenteeism approaches the traditional threshold of statistical significance (0.066), but contrary to expectation it negatively predicts crime. This model explains 87% of the variation, an additional 12% from the single predictor model. It should be noted, however, that both models are heavily influenced by population's positive relationship with both crime and foreclosure. In a bivariate regression, population explains 0.59 of the variance of crime. The variance explained rises to 0.78 if foreclosure is added to this model. Foreclosure explains 0.45 of the variance remaining, net of population's relationship with crime.

One of the drawbacks of variable transformation is that it makes interpreting the results more complex. Using standardized coefficients (see Table 11) provides some advantages. First, it allows you to see the relative strength of the variables. According to this measure, the square-root of foreclosure has the largest single influence on crime in the post-period, followed by mobility, population and retail establishments. Again, it bears mentioning that population and foreclosure are correlated, however, so separating their individual influences is problematic. The significant negative association between Hispanic population and crime, and the 2004-2006 real estate rate have the slightest contribution - nearly the same contribution as the marginally significant variable chronic absenteeism.

Additionally, reporting the semi-standardized regression coefficients provides coefficients in units of standard deviation for the dependent variable, but keeps the independent variable as the original unit. In other words, while we can expect to see a 2.85 increase in square root crime as a result of 1,000 extra people living in an area, we can expect to see an increase of 0.268 of  the standard deviation of the square root of crime with one standard deviation increase in population (1,333.8 people). At first, that appears to make the coefficients less intelligible rather than more. However, this proportion of the standard deviation can also be applied to the untransformed standard deviation to approximate the effect of the variables on the untransformed  dependent variable (Hannon, Knapp & DeFina, 2005).

**Table 11: Model 3: Standardized coefficients & interpretation**

| SqRt Crime 07-9 | Standard. b | Semi-stand. b | SD of variable | # Crime (SD) | #Annual (SD) | # Crime (1 unit X) |
|---|---|---|---|---|---|---|
| **SqRt FC 07-9*** | 0.51 | 0.12 | 64.91~ | 445.20 | 148.40 | -- |
| **Real Estate 04-6**** | 0.11 | 0.61 | 0.18 | 95.60 | 31.87 | 536.59 |
| **Population 2008*** | 0.27 | 0.00 | 1333.83 | 234.62 | 78.21 | 0.18 |
| **Mobility 07-9*** | 0.31 | 0.06 | 5.31 | 275.23 | 91.74 | 51.84 |
| **Chronic Absent*****| -0.12 | -0.04 | 3.31 | -105.16 | -35.05 | -31.75 |
| **Hispanic Pop**** | -0.13 | -0.01 | 10.55 | -112.70 | -37.57 | -10.70 |
| **Retail Est*** | 0.25 | 0.00 | 112.61 | 219.09 | 73.03 | 1.93 |

SD transformed total crime = 14.185; SD untransformed total crime = 877.072

~This is the standard deviation of untransformed foreclosure; square root foreclosure = 4.262

* $p < 0.001$; **$p < 0.02$; ***$p < 0.07$

Continuing the example above, then, we can see that about 1,000 additional residents in a neighborhood result in about 175 additional crimes over three years, or

about 58 crimes annually. Neighborhoods that, between 2004 and 2006, had about 18%

higher sales rate experienced about 96 more crimes in the post-period, or about 32

additional crimes per year. Schools that have about 5 of every 100 students move out of,

or in to, the school attendance zone over the course of the school year can expect to have

92 additional crimes per year, a total of 275 over the course of three years. Areas with

about 113 more employees can expect about 219 additional crimes over three years.

Conversely, areas with Hispanic populations that are 10.5% higher can expect to have

113 fewer crimes over three years, or about 38 fewer crimes annually. The variable

chronic absenteeism, which is marginally significant, indicates that when 3.3% more

students in area schools are absent 10 or more days per school year we can expect to see

about 35 fewer crimes per year.

 Our primary independent variable of interest, foreclosure, was also transformed

by square root. Using the same logic as above, we can approximate that a one standard

deviation change in the square root of foreclosure, which in the untransformed variable is

about 65 homes in a neighborhood being foreclosed on between 2007 and 2009, results in

nearly 445 additional crimes over the same time period, nearly 150 crimes per year, or 7

additional crimes per foreclosure.

It must be remembered that this retransformation creates only approximate

figures. Using the standard deviation of an untransformed variable that is seriously

skewed has obvious flaws. However there is other evidence that support these

conclusions. Correlations and regression coefficients between both transformed and

untransformed variables are strong and statistically significant. Additionally, the

untransformed model predicts nearly the same number of crimes resulting from increases in foreclosure (417 crimes over three years for a standard deviation increase in foreclosure, or 6.4 crimes in the same period, per foreclosure). The same is true of the other variables, with the single exception of chronic absenteeism, which loses any trace of significance ($p = 0.585$).

There are two other elements that may help to explain the distribution of crime in eastern Prince William County. The spatial lag and previous crime rate will be added to the model next.

Given the extremely high correlation between the pre- and post-period crime rate (pairwise correlation = 0.97) before transformation, the nature of their relationship after the post crime transformation requires some further investigation. As can be seen below,
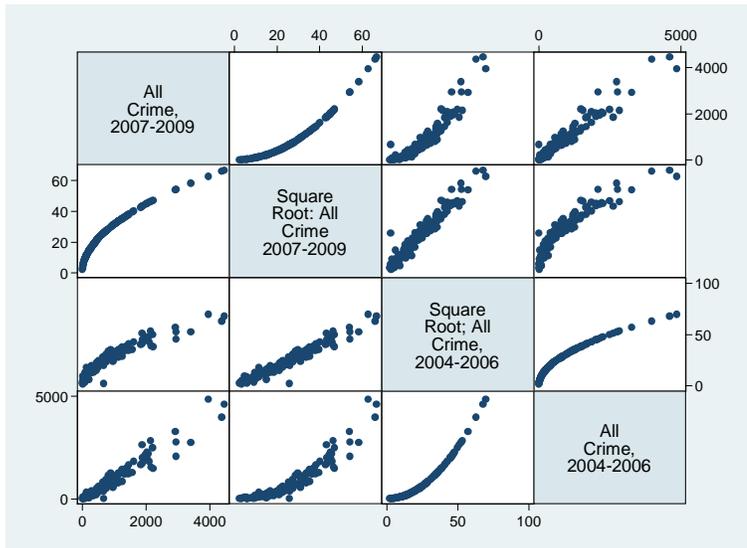


**Figure 8: Scatter plot matrix of post- and pre-crime, with
& without square-root transformation**

transforming post period crime changes the relationship between the two variables from linear to curvilinear. The pre period crime rate could be transformed in order to maintain the linear relationship the variables originally had. Considering the curve of the relationship does not appear to be extreme and the correlation is still very strong (0.92), the variable could also be entered untransformed. However, both ladder and gladder (see figure 8) Stata commands show that square root transformation again achieves the most normal distribution. The scatter plot shows that this transformation recreates the original linear relationship, while more evenly distributing the data throughout the range.

Adding the previous crime rate (transformed) to the regression does have an impact on the model (see table 12) . The variable itself is not only statistically significant (p < 0.0001), but becomes the largest predictor of crime. Using the same estimation process described above (see table 13), an area that experienced about 900 additional crimes between 2004 and 2006 (a one standard deviation increase) could expect to see an additional 630 crimes between 2007 and 2009. The previous crime rate also reduces the impact of a standard deviation increase in foreclosure from 445 to 140 crimes over three years, or 46 incidents per year.

Previous crime rate decreases the impact of the other variables on crime as well. The pre-period sales rate is still significant but also has a reduced impact, from 72 additional crimes for a one standard deviation increase in sales rate to 45 crimes. Likewise, mobility's impact on crime is about halved, from 258 to 126 crimes over three years. A standard deviation increase in retail employment predicts 113 crimes over the post-period rather than 220. Percent Hispanic population predicts 81 fewer crimes rather than 113.

**Table 12: Model 4: All variables**

| Source | SS | df | MS | Number of obs = | | 141 |
|---|---|---|---|---|---|---|
| | | | | F( 9, 131) = | | 342.37 |
| Model | 27021.5 | 9 | 3002.4 | Prob > F = | | 0.0000 |
| Residual | 1148.8 | 131 | 8.8 | R-squared = | | 0.9592 |
| | | | | Adj R-squared = | | 0.9564 |
| Total | 28170.3 | 140 | 201.2 | Root MSE = | | 2.9613 |
| SqRt Crime 07-09 | b | Std. Err. | t | P>\|t\| | 95% CI | |
| SqRt FC 07-09 | 0.528 | 0.153 | 3.460 | 0.001 | 0.226 | 0.830 |
| Real Estate 04-6 | 4.060 | 1.987 | 2.040 | 0.043 | 0.130 | 7.989 |
| Population 2008 | 0.000 | 0.000 | 0.940 | 0.350 | 0.000 | 0.001 |
| Mobility 07-9 | 0.385 | 0.138 | 2.800 | 0.006 | 0.113 | 0.658 |
| Chronic Absentee | -0.233 | 0.160 | -1.460 | 0.148 | -0.548 | 0.083 |
| Hispanic Pop | -0.125 | 0.045 | -2.770 | 0.006 | -0.214 | -0.036 |
| Retail Est | 0.014 | 0.003 | 5.500 | 0.000 | 0.009 | 0.020 |
| SqRt Crime 04-6 | 0.695 | 0.046 | 15.120 | 0.000 | 0.604 | 0.786 |
| Spatial Lag Crime | 0.064 | 0.164 | 0.390 | 0.697 | -0.261 | 0.389 |
| Constant | 4.317 | 3.362 | 1.280 | 0.201 | -2.335 | 10.968 |

Interestingly, the 2008 population loses statistical significance. Likely this does not indicate that there is no relationship between population and crime, but that there is a high correlation between population and crime. This can be seen in the scatter plot below, and the correlation coefficient (0.78). Although the VIF does not exceed the recommended levels, these two variables are likely too highly correlated to work well in the model together. To some degree, the same is likely true of the other variables in the model as well: higher crime is likely to exist in conditions that predict higher crime in the future.

**Table 13: Model 4: Standardized coefficients & interpretation**

| SqRt Crime 07-09 | Standard. b | Semi-stand. b | SD of variable | # Crime (SD) | #Annual (SD) | # Crime (1 unit X) |
|---|---|---|---|---|---|---|
| SqRt FC 07-09* | 0.159 | 0.037 | 64.912~ | 139.104 | 46.368 | -- |
| Real Estate 04-6*** | 0.051 | 0.286 | 0.178 | 44.731 | 14.910 | 251.018 |
| Population 2008 | 0.032 | 0.000 | 1333.835 | 28.417 | 9.472 | 0.000 |
| Mobility 07-9** | 0.144 | 0.027 | 5.306 | 126.386 | 42.129 | 23.856 |
| Chronic Absentee | -0.054 | -0.016 | 3.311 | -47.625 | -15.875 | -14.384 |
| Hispanic Pop** | -0.093 | -0.009 | 10.548 | -81.305 | -27.102 | -7.718 |
| Retail Est* | 0.114 | 0.001 | 112.614 | 100.249 | 33.416 | 0.877 |
| SqRt Crime 04-6* | 0.720 | 0.049 | 895.622~ | 631.317 | 210.439 | -- |
| Spatial Lag Crime | 0.012 | 0.005 | 2.537 | 10.086 | 3.362 | 3.947 |

SD transformed total crime = 14.185; SD untransformed total crime = 877.072

~SD of untransformed variable. Square-root foreclosure = 4.262; square-root crime = 14.6993.

* $p < 0.001$; **$p < 0.01$; ***$p < 0.05$

Chronic absenteeism also loses its marginal significance ($p = 0.148$). The spatial lag is not significant ($p = 0.697$). In other words, having a higher crime rate in the past is associated with a higher crime rate in the future, but higher rates of crime in adjacent neighborhoods do not appear to influence the crime rate. The latter conclusion is made with a note of caution, however. The spatial lag's lack of significance may also indicate that the TAZs are, on average, too large to pick up on the influence of neighboring TAZs, or there are simply so many gaps between TAZs because of dropped observations. At 0.96, the already very high R value is slightly higher.

Table 14 summarizes the results of the four models presented above. The number of crimes committed in an area during the three years before the foreclosure crisis occurred was by far the largest predictor of crime between 2007 and 2009. Foreclosures remain a significant predictor of crime in every model, although the impact of those

foreclosures decreases somewhat when other controls, particularly previous crime rate, are included. Higher home sale rates in the years prior to the foreclosure crisis, greater mobility during those years, and higher number of retail employment in an area all predict higher rates of crime. Higher percentages of Hispanic population, on the other hand, predict less crime.

**Table 14: Summary of results: Standardized coefficients**

| N = 141 | Model 1: Crime 07-9 | Model 2: Sqrt Crime | Model 3: Demo & Envir | Model 4: All Vars |
|---|---|---|---|---|
| **Foreclosure 07-9** | 0.832* | | | |
| **SqRt FC 07-09** | | 0.869* | 0.508* | 0.159* |
| **Real Estate 04-6** | | | 0.109** | 0.051** |
| **Population 2008** | | | 0.268* | 0.032 |
| **Mobility 07-9** | | | 0.314* | 0.144* |
| **Chronic Absentee** | | | -0.12*** | -0.0543 |
| **Hispanic Pop** | | | -0.129** | -0.093* |
| **Retail Est** | | | 0.25* | 0.114* |
| **SqRt Crime 04-6** | | | | 0.720* |
| **Spatial Lag Crime** | | | | 0.012 |

*p < 0.001; **p < 0.05 ***p < 0.1

## Discussion

Using multiple linear regression, this research found a small but statistically significant relationship between crime and foreclosure in a suburban setting. This relationship held even when demographic and environmental variables, and previous crime rate were added to the model. Previous crime rate of a neighborhood is the largest predictor of crime between 2007 and 2009, but both mobility measures and retail employment also positively predicted crime and were statistically significant. Percent Hispanic population was also statistically significant, however it negatively predicted crime. Population did not predict crime in the final model, likely because of its relationship with crime rate in the pre-period. No relationship between crime and chronic absenteeism or the spatial lag was found in any test.

While some results of testing were expected, the results of percent Hispanic, spatial lag and chronic absenteeism were contrary to expectations. Two theoretically important variables, economic disadvantage and percent immigrant population, were not included in the model because of multicollinearity. Other demographic variables were not included because insignificant correlations indicated that they were unnecessary in the model.

Some of these findings agree with previous research, but some of the results are quite intriguing, in particular because of the uncommon setting of this research. Despite

the relatively low rate of crime in Prince William, and within the context of a falling

county-wide crime rate, the large numbers of foreclosures that occurred at this location

during this time period made it an appropriate research setting. It is likely that

foreclosures did not concentrate in this location by random chance. The rapid growth of

the area and the socio-economic makeup of its residents made foreclosures more likely

given the conditions in the banking community at the time.

Before 2007 it seemed very unlikely to most people that foreclosures would

concentrate in such numbers that the homes would not be reabsorbed quickly in relatively

affluent places. Prior to the foreclosure crisis, Immergluck and Smith (2006a) asserted

that the relationship between foreclosure and crime they found in low income urban areas

was unlikely to be found in places like Prince William County, Virginia. This conclusion

was likely not made because the authors believed that the effects of foreclosure would be

less destructive in higher income places, but that foreclosures themselves would be

unlikely to accumulate in such a way in these places. While it is possible that the

confluence of factors that created the foreclosure crisis in unexpected places across the

nation will never happen again, we should not be confident that the noxious effects of

foreclosure are unique to cities.

**Foreclosure**

Neighborhoods that experienced elevated numbers of foreclosures, measured by

any bank foreclosure filing registered between 2007 and 2009, also experienced

additional crimes during the same time period. Controlling for previous crime rate,

population, and other factors, neighborhoods that had about 65 foreclosures over the

mean during those three years also had about 140 additional calls for police service than they otherwise would have experienced. The possible social, physical, and psychological effects of foreclosure that may lead to additional crime are outlined above.

There are a variety of reasons why greater numbers of foreclosure would lead to increases in crime. The financial pressure and shame associated with being unable to pay the bank and the possibility of losing a home may strain relationships within households or communities. The 'forced' relocation of the people whose home was foreclosed may also end social ties or leave gaps in community organizations. Alternatively, disorder is likely to grow around a home left vacant or one whose owners are unable to improve, which may attract crime. Another possible explanation for increased crime is that fewer people in a neighborhood may leave fewer people to act as capable guardians. While this research showed the positive relationship between crime and foreclosure, why this was seen cannot be definitively answered with this dataset. We can make some educated guesses, however.

While we do not have any further information about vacancy rates, disorder, friendship ties, or emotional distress for the people and homes involved in foreclosure, we can use post hoc testing to probe two areas. First, examining the types of crime that were most likely to increase with increased foreclosure may provide some information. Second, examining the conditions of the places where foreclosure was most likely to occur may also provide clues as to the reason why increased foreclosures led to increased crime.

Using rates to help control for the relationship between population and crime or foreclosure, correlations between foreclosure and violent crime, property crime, disorder and domestic calls for service were examined. The correlation between total crime rate between 2007 and 2009 and the foreclosure rate is 0.34, a moderate relationship. There is fairly wide variability between foreclosure and broad types of crime within that total rate, however. The least well correlated broad type of crime is violent crime (0.17), followed by disorder (0.26); stronger relationships are seen with property crime (0.43) and domestics (0.53).

The robust correlation between foreclosure and calls for service reporting domestic violence, particularly in contrast with relatively weak relationship between other violent crimes and foreclosure, points most directly to strained relationships within households. We cannot deduct if this is a direct or indirect result of higher rates of foreclosures, although whatever the stressors are, they do not appear to extend outside the home. Clearly foreclosure and losing a home would be a stressful experience for most people, one which could directly lead to increased likelihood of domestic violence. There could also be indirect impacts for those near to foreclosures: reduced property values that lead to being 'underwater' on the mortgage and financial strain, or the loss of neighbors and friends who provided emotional or practical resources previously in times of need. Increased rates of unemployment could be related to both higher levels of foreclosure and incidents of domestic violence. While there is no employment data available for the study period, there is a strong correlation (0.44) between unemployment measured by the 2012 American Community Survey 5-year estimates and foreclosure in census tracts. There is

no reason to believe that increases in foreclosure would increase reporting of domestic violence incidents.

Property crimes, the second strongest correlation, tends to point more toward lower guardianship: perhaps from adults working longer hours, vacancy, or even broken social or community ties. The lesser relationship between foreclosure and disorder could led one to assume that of the above options, vacancy was not an important issue in most of these places. However, vacancies in a suburban setting may have different effects than in cities where they are documented as attracting drug and prostitution activity. Suburban areas differ greatly from cities in land use patterns, for example. There are fewer homes directly facing major thoroughfares, and very little mixed retail and residential land use within the same block. While vacant homes may 'advertise' their presence, and an opportunity for crime, in the same way in both settings, fewer people unconnected to someone in the neighborhood would have the opportunity to notice it in the suburban area. Loss of anonymity may make such an opportunity less appealing in a suburban location.

Another way to examine the data that is available is to look at elements that made foreclosure more likely. The strongest correlations between foreclosure in the post-period and pre-period controls are similar to those that have the strongest relationship with crime in the post-period: economic disadvantage, Hispanic and immigrant population, and mobility in the pre-period all correlate well with foreclosure in the post-period. In other words, places that had higher rates of crime, economic disadvantage and mobility were more likely to experience higher rates of foreclosure, which in turn increased crime,

economic disadvantage and mobility. As previous research has indicated, foreclosure was more likely to occur in places that had higher concentrations of Hispanic and immigrant population, because these populations were more likely to be sold high risk mortgage products, and were disproportionately impacted by the downturn in the economy. In contrast, there are negative correlations between foreclosure in the post-period and percentage of white or other populations.

While this research focused the negative effects of foreclosure, there is no reason to assume that all of the effects of foreclosure were negative for the individual or the community, particularly in the long run. Once foreclosure and displacement occurred, the pressure and stress of the debt that an individual or family could not pay would be removed. In an ideal situation, the family in question would land in housing that they *could* afford, pay off debts that may have accrued during the foreclosure period, and begin again with a clean slate. Once the financial situation was stabilized existing relationships could be mended, new relationships formed, and new goals formed and realized.

As can be seen in Figure 3, while there was a lag between the rise in foreclosure and the rise in bank sales, in the aggregate most foreclosed homes in Prince William did not remain bank owned for long periods. While the value of homes across the region fell, bank owned homes could typically be purchased at even lower costs. Because of the financial crisis banks were reluctant to extend loans to all but borrowers with strong credit and resources. Thus, at least in theory, bank-owned homes were purchased by people well able to afford them, improve them, and participate their communities. Lower

home values likely had other positive effects on communities too. For those who could qualify for the new, more stringent loan requirements, there were many more affordable homes for sale. It also may be reasonable to assume that many homeowners who were underwater on their mortgages but could afford to pay were less likely to move until values rose again, increasing the stability of the neighborhood.

**Mobility**

Mobility was measured in two ways: the valid sales rate between 2004 and 2006, and the schools' measure of mobility of students over the course of a school year. Both measures did show a positive, significant relationship with crime in these areas. Neighborhoods that had sales rates that were 18% higher than the mean sales experienced 45 additional crimes. Schools that have about 5 of every 100 students above the mean move out of, or in to, the school attendance zone over the course of the school year could expect to have about 126 crimes over the three years between 2007 and 2009.

Mobility in the post-period was also highly correlated with economic disadvantage. While economic disadvantage needed to be dropped from the model, we can guess that this variable would also be significant if it had remained because of this correlation and its significance when included alone. Poverty has long been linked with crime, but a more inclusive measure of economic disadvantage likely had more explanatory power as crime relates to foreclosure in this setting.

Including pre-period sales rate or mobility does not modify foreclosure's relationship to crime. There is a strong correlation between the sales rate between 2004 and 2006 and foreclosure between 2007 and 2009. Areas that are more stable are less

likely to have crime, but these areas are also less likely to have high rates of foreclosure. Somewhat surprisingly, mobility in the post period is only moderately correlated with foreclosure rates. This is likely due to the mobility measure picking up on not just movement on home sales but also moment among the rental population.

**Demographics**

Previous research indicates that people of color are more likely to be economically disadvantaged and live in places with more crime. As outlined above, previous research has found that people of color were more likely to receive subprime loans, regardless of income levels, and those loans were most likely to end in foreclosure during this foreclosure crisis. This research did find a link between foreclosure and crime. Correlations indicate foreclosure is more likely in areas with higher percentage of Hispanic or Black people, and even more likely in areas with more economic disadvantage. Despite these risk factors however, the only statistically significant relationship found between crime and a racial or ethnic group was a negative relationship between percent Hispanic and crime. Percent Black was not included in the model at all because the correlation table did not suggest that it contributed to the understanding of crime in these places at all.

Sampson and Groves hypothesized in 1989 that dense social networks could mediate the relationship between crime and the social characteristics of a neighborhood. This theory could explain the statistically significant negative relationship between percent Hispanic and crime found in this research. Correlations run prior to testing show a moderate, positive relationship between percent Hispanic and crime (0.38), a stronger

relationship between economic disadvantage and crime (0.42), and a very strong

relationship between percent Hispanic and economic disadvantage (0.85). Indeed, that

very strong relationship was one of the reasons why economic disadvantage was removed

from the model[5]. The bivariate regression between crime and either percent Hispanic or

percent immigrant is also positive and significant, but the variables lose significance once

mobility (or economic disadvantage) is controlled for, and 'flips' negative once either

population or foreclosure is also included in the model. This suggests that people who are

Hispanic and / or recent immigrants tend to live in areas of Prince William with greater

concentration of mobility (and economic disadvantage), population density, and higher

foreclosure rates, and these areas tend to have more crime. However, there is less crime

than we would otherwise expect in areas that have these characteristics of disadvantage

but also have higher concentrations of Hispanic and / or recent immigrant population.

Informal post-hoc testing using census blocks and demographic information from

the 2010 census restrains this finding, which runs counter to most theories of crime and

popular opinion, to some degree. As in the full model, percent Hispanic in 2010

significantly predicts calls for police service in a bivariate regression. The variable loses

significance when economic disadvantage (using percent receiving Supplemental

Nutrition Assistance Program, or SNAP) is added, but does not become negative with the

inclusion of the other variables.

However, less crime and other negative outcomes in immigrant enclaves which

are otherwise disadvantaged have been increasingly documented by researchers over the

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[5] Post testing does show that including economic disadvantage does predict crime when included with foreclosure, although it loses that significance when the 2004-2006 crime rate is included.

last 10 years, and is called the 'immigrant paradox'[6] by some. In a review of research,

Zatz and Smith (2012) cite 18 studies that report negative or null effects of immigration,

at individual or aggregate levels, and examined at one or multiple points of time.

Sampson (2008) goes so far as to argue that the increase in immigration between the mid-

1990s through the early 2000s contributed significantly to the historic drop in crime

during the same time period. It is thought that enclaves of immigrants with similar

backgrounds provide each other support and protection. This protective insulation, which

has been documented as extending outside the ethnic group in areas where it has been

found, depends on a certain concentration of immigrants. That theory provides support

for the idea that this protective effect is related to strong family and social ties within

these communities as Sampson and Groves (1989) suggest.

The percentage of population that is Black was not included in any model because

correlations suggested there was no relationship between the measure and crime (0.12).

Post testing confirms this lack of relationship. There is a stronger correlation (0.27) if

information from the 2010 census in census blocks is used instead, but percent Black is

does not significantly predict calls for service in the bivariate regression. Previous

criminology research in urban areas from the 1970s through the 1990s frequently

includes percent or number Black in models as an individual, or one piece of a scale,

predictor of crime. Regardless of researcher position of the relative offending patterns of

Black and White people, people who are Black, particularly young Black men, are more

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[6] The term encompasses a wider range of life factors that first and second generation immigrants tend to have better than expected outcomes on, given their likely lower economic resources, political capital and neighborhood conditions.

likely to be murdered, killed by a firearm, and arrested compared with other racial groups. There are perhaps dozens of possible reasons why this is so, and delving too deeply into them is beyond the scope of this research. Instead it is perhaps sufficient to say that in many older urban areas of the United States significant numbers of Black children have and do grow up with a toxic combination of family disruption, unemployment, and personal poverty at the individual or family level, in racially segregated communities that are socially isolated and have a poverty deeper than anything White children experience (Sampson & Wilson, 1995; Sampson & Bean, 2006).

There is a moderate relationship between percent Black and economic disadvantage (0.31) in Prince William between 2007 and 2009; recall, however that the measure of economic disadvantage used here is more inclusive than that of the federal poverty line. Nearly everyone in Prince William County, regardless of age or income bracket, is here because they choose to live here; fifty years ago the population was an eighth of its current levels. This is in sharp contrast to places in urban areas, described first by Shaw and McKay, where anyone who could afford to move did so, and all who were left behind were the most desperately poor.

Perhaps more importantly, while there are variations in income levels and race across neighborhoods, there is nothing in this community that can be described as racial or even economic segregation. A measure of heterogeneity was constructed, (following Blau, 1977) but not used in this research as there was little variability in the measure. The heterogeneity scale runs between 0 and 0.8, with 0 indicating complete homogeneity and any measure over 0.5 indicating high heterogeneity. The range of this variable in these

areas of Prince William County was between 0.51 and 0.78, with a mean of 0.69, indicating that these areas of Prince William are uniformly diverse. The elements of concentrated disadvantage that Sampson and colleagues (1997) describe in only Black areas of Chicago, for example, which reliably predicts crime in urban areas does not exist in Prince William County today. As a result, percent Black does not predict crime in Prince William. More varied research settings in criminology may help to provide further evidence that concentrated disadvantage predicts crime more efficiently than the prevalence of any one racial group.

Finally, while suburban places may lack the resources that would provide more assistance to individuals who are struggling, the fact that the people or families who are struggling are small islands in a sea of relative prosperity allow the community as a whole to recover more quickly than if all of those who are struggling are segregated in few locations.

**Chronic Absenteeism**

The results for chronic absenteeism ran counter to expectations. Rather than predicting higher levels of crime, neighborhoods that had more absenteeism were predicted to have lower levels of crime. Previous research indicates that students who are absent 10 or more days in a school year are more likely to experience a host of negative outcomes. It is a widely used, reliable indicator for at-risk children and schools in the field of education; indeed this is why schools are required to publicly report the number annually. The variable has also been used previously in crime research, as an indicator of truancy and a community's lack of control over or supervision of its youth.

Further investigation of this variable in this research shows that chronic absenteeism does conform to expectations with regard to the other variables in the model; this is to say, schools that have a higher than average percentage of chronic absenteeism also have higher than average mobility, economic disadvantage, immigrant and non-white populations. The reverse is true of schools with rates of chronic absenteeism that are lower than average. The bivariate relationship between crime and chronic absenteeism, likewise, is positive and significant. The regression coefficient for chronic absenteeism 'flips' negative once mobility and either foreclosure or population are included in the model. The correlation between chronic absenteeism and mobility is quite high (0.84) however, which may indicate that multicollinearity is making this variable unstable even though VIF scores did not exceed recommended levels. Given that it does not explain a large amount of the variance of crime (0.27), and results do not substantively change if it is not included, chronic absenteeism could be dropped from the model.

## Limitations

There are a number of significant limitations to this study which are introduced from the availability of data, the measures and setting used, and the analysis. These limitations could have affected the internal, construct and external validity of this research. This section will acknowledge and discuss these limitations.

Establishing a causal relationship between concentrations of foreclosure activity and crime requires that other plausible explanations for observed changes in the crime rate be accounted for; this relates to the internal validity of the research (Trochim, 2005).

There are at least two factors not included in this model that could potentially explain part of any relationship between foreclosure and crime.

Neighborhood incivilities, or signs of physical disorder, are thought to play a significant role in increasing crime rates under some criminological theories such as broken windows (Wilson & Kelling, 1982). While the role of physical incivilities is likely not as large as some may have originally thought (Sampson & Raudenbush, 1999), there has been some evidence of its relevance (Markowitz, Bellair, Liska, & Liu, 2001). Despite potential benefits, a measure of physical disorder is not included in this model, because there was no existing data source that systematically collected evidence of disorder in this place and time. Direct systematic observation, for periods of time that were over before this research began, was impossible.

There were also historical events that occurred in the research setting during the time frame studied that may have influenced residential stability, the rate of foreclosure, and/or the rate of crime. The Prince William County Board of Supervisors, the local governing body, instituted a 287(g) immigration policy late in 2007 that directed police to investigate the immigration status of any person lawfully detained by Prince William County Police ("PWCPD Immigration Policy," n.d.). Throughout 2007 there was highly publicized, emotionally charged public debate regarding this policy (Guterbock et al., 2009). Despite efforts by the County's Police Department and the Chief of Police, misinformation and confusion about the details of the policy were widespread, particularly in the Hispanic community. While many believe this policy resulted in large numbers of immigrant residents leaving the county, there is no way to separate the effects

of the foreclosure crisis, increases in unemployment (particularly in the construction industry), and the change in police procedures (Guterbock et al., 2009). There was sufficient reason to believe that the Hispanic population of Prince William may have increased in the first half of the decade, then decreased again before the 2010 Census was complete.

Mobility in the rental population is perhaps less strongly estimated than the Census would provide for. More than 70% of housing units in Prince William are owner-occupied, and the mobility rate of public school students did pick up on movement of non-homeowners. This is dealt with in part by using more than one measure of mobility. The use of school data for demographic information may have also overestimated both economic disadvantage and population estimates of non-White people. It could be argued that the measure of economic disadvantage was more sensitive than the Census' measure of poverty, however, and thus more instructive in this setting. Although housing is more affordable in Prince William than other localities near to the District of Columbia, there are few if any homes that a family living in poverty would be able to afford. The average price for a home in Prince William in 2005 was more than $330,000; an annual mortgage payment would amount to $5,000 more than the federal poverty line that same year. Thus, in this setting, a measure of economic disadvantage that is more inclusive may be more appropriate. While estimates of non-White populations may have been inflated, there is no policy busing across attendance lines or other reason to believe that the heterogeneity of neighborhoods is not real.

The variables I used to measure the constructs of my theoretical model also have a number of limitations. These limitations may affect the construct validity of this research. First, foreclosure may be a choice for some borrowers, rather than something forced upon them. These are foreclosures that occur when homeowners stop paying their mortgages even though they could continue to pay them. If a large percentage of foreclosures were chosen, then their effect on the community may be no different than that of an ordinary move. There is no way to determine the actual prevalence of this population, as a whole or within my sample. Given the ramifications of foreclosure to the borrower, prior research has indicated this population is likely not large (Edminton & Zalneraitis, 2007; Guiso, Sapienza, & Zingales, 2009).

Second, it is important note that vacancy, or even resident change, is not an automatic result of foreclosure, even if a home is bank-owned for a period of time. Some foreclosed homes are occupied by renters, who may stay in the home throughout the foreclosure and into new ownership. Some homeowners stay until they are forcibly evicted by authorities, which may not occur until well after the property reverts to bank ownership. If the property is purchased by a third party, the foreclosed owners may stay on as renters of the property. The lower correlation between disorder crimes and foreclosure tend to indicate that vacancy may not have been a major issue facing neighborhoods in these areas, but there is no way to be certain with this dataset.

At the opposite end of the spectrum, as noted earlier, some homeowners may choose to move out as soon as they are sure they will be unable to continue paying on their mortgage, leaving a vacancy throughout the foreclosure process. Foreclosures may

also become investment properties, purchased by someone intending to "flip" it to a new buyer, and thus remain vacant until a second post-foreclosure purchase is made. It is reasonable to assume that most foreclosures result in change of residents, despite there being no hard evidence that this is the case.  The same cannot be said for vacancy, which is one reason why it was not introduced into this model.

Third, as noted above, the real estate data reports an exact date of recordation of deed transfer, which may not be the same date on which the foreclosure auction occurred. There is no reason to believe that foreclosures occur after the date of deed recordation but many of them may have taken place before, sometimes well before, the date of recordation. While there is no way to know, the effect of this should be minimized by the steps of aggregating the number of foreclosures to a yearly measure and including a three month pre-foreclosure period.

Fourth, the demographic and economic information used in this research is gathered from one subset of the research settings' population: public school children. Data from PWCPS is less than ideal because they may overestimate the percentage of racial and ethnic minorities in some areas. Criminological and sociological studies often use the Census as a secondary source of socio-economic data. Census data was not used in this study for two reasons. First, information from the 2000 census was quickly superannuated in Prince William County, because of the County's population growth, both in numbers and diversity, in the first years of the new century. According to the American Community Survey 2006-2008 three year estimate, 33.5% of households in the County moved in to their residence (at the time of the survey) between 2000 and 2004,

and nearly 37% moved in after 2005. Further, more than 25% of all households lived in a home that was built after the 2000 census.  In this setting of rapid growth, any conclusions drawn from demographic data from 2000 and other data sources in the middle of the first decade are likely to be problematic (McClain & Fowler, 2008). Secondly, data from the census would not capture potential variation that existed from year to year. Between 2000 and 2006, Prince William County's population rose rapidly and became much more diverse. Around 2007, growth began to stall and there is reason to believe that some subsections of the population, particularly Hispanic residents, may have at least temporarily decreased. Some criminological theories point to periods of transition as being particularly problematic, so data that captures those net annual changes may be more valuable in this instance.

Finally, values of socio-economic variables within each TAZ were estimated by intersecting each school attendance areas that overlapped inside of TAZ areas. This method of apportioning population into TAZs assumes a geographically even distribution of population and qualities across each TAZ. There is no basis for that assumption. From an overlay of the 2010 Census, it can be seen that the estimated population of the study area is reasonable. However, it cannot be determined how accurate each individual estimate is.

Regarding external validity, this research examines the relationship between foreclosure and crime in only one setting, which limits the extent to which it is possible to make generalizations to other places and times. The setting is in many ways different than the average municipality: compared to the national average, Prince William County

has a higher average income, a more educated population, and higher rates of residential instability. On the other hand, aggregating data from multiple jurisdictions can be problematic when the data sources are unique to each jurisdiction, and can obscure variation. While this research setting is valuable in that there is very little criminological research in suburban areas, there is also no accepted, formal definition of what a suburb is, which further confuses its generalizability.

In several ways the data used in this research model were less than ideal for regression. Transformation improved the normality of the residuals, but marked non-normality in the tails of the data remained. Violation of this assumption of regression can invalidate p-values for t- and F-tests. Transforming post crime and foreclosure also had the unintended effect of undoing the linear relationship between pre-crime rate and foreclosure. The transformation of the pre-period crime rate was then necessary. Finally, transformation of variables makes interpretation of the results much less clear-cut.

Multicollinearity, particularly between economic disadvantage and mobility, and percent immigrant and percent Hispanic populations, was such a significant problem that economic disadvantage and percent immigrant were dropped from the model. While test results fell to acceptable levels after the variables were dropped, the solution is less than ideal since those variables were theoretically important to the model.

Despite the limitations listed above, this research was worthwhile in a number of respects. It did find that foreclosures increased crime, even within a setting that is overall less likely to experience high crime rates. Despite this similarity found across settings, it

also suggested that criminogenic factors that are often taken for granted in criminological

research, should not be assumed across settings.

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**Biography**

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